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EAST INDIA (ROYAL INDIAN ENGINEERING COLLEGE).

Remodelling of Course of Instruction and Retirement of certain of the Professors and Lecturers.

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REPORT

OF THE

BOARD OF VISITORS

(Dated 25th March 1901),

AND

MINUTES OF EVIDENCE TAKEN BEFORE THEM.

Presented to both Houses of Parliament by Command of His Majesty.

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BOMBAY BRANCH
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EAST INDIA (ROYAL INDIAN ENGINEERING COLLEGE).

Remodelling of Course of Instruction and Retirement of certain of the Professors and Lecturers.

REPORT

OF THE

BOARD OF VISITORS

(DATED 25TH MARCH 1901),

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MINUTES OF EVIDENCE TAKEN BEFORE THEM.

No. 1.

LETTER from Sir W. R. Anson, Bart., M.P., to the Secretary of State for India, dated House of Commons, 6th March 1901.

Dear Lord George Hamilton,

You have suggested that I should put down in writing the chief points concerning the Cooper's Hill case, dealt with in the interview which you kindly allowed to Mr. Talbot, Mr. Lecky, Sir M. Foster, Sir R. Jebb, and myself. I am very glad to do so.

Our request for an inquiry, and in the meantime for a suspension of the decision as to dismissals, was not based wholly on the alleged hardships to individuals, but on some wider grounds disclosed in the papers which you laid before Parliament.

We did not question the need for some changes in the course of studies, as suggested in Colonel Ottley's memorandum, though it must be borne in mind that some of the statements in the memorandum have been questioned by very high authority. But we urged that there was something amiss in the constitution of the College if men who had served there for many years, and who were not alleged to be incompetent or unwilling to teach, were deprived of all opportunity of a hearing, when the President recast the course of studies in which they were concerned in such a way as to involve proposals for their dismissal.

We thought that even if the experience of these gentlemen would not have been of value to the President, they should have been invited to say whether they could adapt themselves to the new arrangements before the scheme was put into final shape and assumed to be incompatible with their continued employment.

We also submitted that the Visitors had not received assistance which might have been of use to them in dealing with the memorandum.

When they considered, and in the main adopted, Colonel Ottley's recommendations, it does not seem to have been suggested to them that the teaching staff had not been consulted, or that they might have been consulted with advantage, or at any rate that the gentlemen whose dismissals were in contemplation had a right to be heard.

We were anxious that either by communication with the Visitors, or in any manner which you thought desirable, some inquiry should be set on foot which would not only prevent the occurrence of any present hardship, but would bring about such a change in the relations of Visitors, President, and Teaching Staff as would make a recurrence of the existing difficulty impossible.

It is now possible, and has actually happened, that a teaching staff of long experience, willing and competent to teach, may find their scheme of studies altered and the dismissal of some of them determined upon, without a hearing by the President and with no opportunity of an appeal to the Board of Visitors.

This does not seem to us to be just to individuals nor in the interest of the studies of the place, and we think that the Visitors, if the matter was presented to them in this light, might desire to suspend action on the memorandum pending an inquiry into the whole subject of the relations of Visitors, President, and Teaching Staff.

Many persons eminent in science have expressed a strong opinion that the proposed dismissals will act injuriously on the scientific education of the country. These opinions cannot be disregarded, and the members for the Universities, who have no other object in view in this matter than the advancement of the higher education, are bound to press for a reconsideration of the subject by such means as are available to them.

Believe me
Yours very truly,
(Signed) WILLIAM R. ANSON.

No. 2.

LETTER from the Secretary of State for India to Sir W. R. Anson, Bart., M.P., dated 11th March 1901.

My dear Sir William,

I have to thank you for your letter, which is a succinct account of the views of the deputation from the Universities who came to see me on the subject of the reforms proposed to be introduced at Cooper's Hill College.

That College is in such a condition that it must be either reformed or abolished. I am opposed to its abolition, and have used my influence against that proposal, though it had the unanimous support of the Committee to enquire into the cost of the College appointed by Lord Kimberley in 1894. I have therefore to deal not with abstract or academical propositions, but with a concrete difficulty:—how can the College be put into that state of practical educational efficiency which, compared to its cost, will justify the Indian Council in allowing it to continue to be a burden upon Indian revenues?

It was urged by the deputation that no reforms such as we proposed ought to have been sanctioned, until the teaching staff, and especially all those personally affected by the changes, had had the fullest opportunity of stating their views and objections to the proposed reorganisation. This is, so far as the public services are concerned, a novel doctrine, which, if pushed to the extent advocated, would render schemes of reorganisation impracticable where personal interests were prejudicially affected to any considerable extent by the reforms proposed. This practice may be the custom in collegiate management, upon which I can speak with no authority, but it certainly does not prevail in the administration of the great public departments of the country.

The procedure proposed by the deputation to give effect to this doctrine is to appoint an outside, and therefore irresponsible, Committee, who are by enquiry to supervise and suspend for the time being all the authorities responsible for the conduct of the College, viz., the Council of India, the Board of Visitors, and the President of the College, until the Committee have come to a conclusion upon all the changes which the authorities in

combination have unanimously proposed. Such a course, if assented to, must lead to the abolition of the College. No public authority would assent to being made financially responsible for the maintenance of a questionable institution over which they were unable, through outside interference, to exercise any administrative control, and least of all a body, such as the Council of India, which by statute is specially exempt from all external pressure or control upon all questions involving a charge upon Indian revenues.

I am, whilst unable to assent to the form of the suggestion made to me by the deputation, ready to go as far as I can in endeavouring to meet the substance of their complaint, but any action that I may so take can only be through the recognised and responsible authorities attached to the College.

I have, therefore, placed myself in communication with the Board of Visitors, and they have stated their readiness to meet to hear at once what those affected by the changes may wish to urge against them.

The evidence so given will be taken down by a shorthand writer. The Board will then report to the Secretary of State in Council whether their views have undergone any modification from the evidence so obtained. The orders of the Council in reference to Cooper's Hill College will not come into operation until the Council have received and considered this report.

The controversy, which has unhappily during the last two months raged round the College, has very clearly brought to light the irreconcilably different views held, on the one hand by all the authorities outside the College who are responsible for its well being and finance, and on the other hand by some of the teaching staff inside the College as to the educational proficiency and cost of the instruction given.

It is clear to me that the channels of communication between those actually teaching and those in authority over the teachers, viz., the President and Visitors, should be widened and quickened. A divergence of opinion such as has been revealed is detrimental, if not fatal, to harmonious co-operation. I therefore propose to ask the Universities of Oxford, Cambridge and London to each nominate a Visitor, to be an addition to the present Board. I shall ask the Board, when so reconstituted, to appoint a committee, including the above, to enquire into and report upon the working, discipline, and constitution of the College, and the relations of the Visitors, President, and Teaching Staff.

I have written thus fully to you, as I much appreciate the courtesy and consideration with which the deputation treated me, and they, in their turn, will, I hope, recognise that in the proposals I now make I have endeavoured to act reciprocally towards them.

Believe me,
Yours very truly,
(Signed) GEORGE HAMILTON.

No. 3.

ROYAL INDIAN ENGINEERING COLLEGE.

REPORT of the BOARD OF VISITORS, dated 25th March 1901.

Present:

SIR CHARLES H. T. CROSTHWAITE, K.C.S.I. (Chairman).
SIR JOHN WOLFE BARRY, K.C.B., F.R.S.
MR. HUGH LEONARD, F.S.A., M.I.C.E.
MR. JAMES MANSERGH.
SIR W. H. PREECE, K.C.B., F.R.S.
SIR W. S. S. BISSET, K.C.I.E., R.E.
SIR ALEXANDER M. RENDEL, K.C.I.E.
SIR COURTENAY P. ILBERT, K.C.S.I.

In accordance with the instructions conveyed to us, we met at the India Office on the 14th, 19th, and 21st March, to hear and examine the professors and other members of the staff affected by the proposed changes in the organization of the College. We were informed that it was not intended to enter into the general questions of the administration of the College and the constitution of the staff, but to confine the inquiry to the subject of the changes recently made on the advice of the Board of Visitors and to the effect in each case.

We began by examining the seven Professors and Lecturers whose appointments are under notice of termination, viz. :—

Mr. H. McLeod, F.R.S., Professor of Chemistry.
Mr. A. H. Heath, A.M.I.C.E., Assistant Professor of Engineering.
Mr. W. N. Stocker, M.A., Professor of Physics.
Mr. T. A. Hearson, M.I.C.E., Professor of Hydraulic Engineering and Mechanism.
Mr. T. Shields, M.A., B.Sc., Demonstrator in Physics and Instructor in Electrical Engineering.
Mr. J. C. Hurst, Lecturer in Accounts.
Mr. P. Reilly, Demonstrator in the Mechanical Laboratory.

We also examined the following gentlemen,—

Colonel J. W. Ottley, C.I.E., President.
Dr. A. W. Brightmore, D.Sc., M.I.C.E., Professor of Engineering Construction and Surveying.
Mr. R. J. Woods, M.I.C E., Instructor in Surveying.
Mr. G. M. Minchin, M.A., F.R.S., Professor of Applied Mathematics.
Mr. A. Lodge, M.A., Professor of Pure Mathematics.

Mr. A. Hicks, Instructor in Geometrical Drawing and in Estimating.
Dr. F. E. Matthews, Ph.D., Demonstrator in Chemistry.
Mr. P. Groom, M.A., Lecturer on Botany and Entomology.

Of these last eight gentlemen, the first six attended at our request. Dr. Matthews and Mr. Groom came in answer to a general invitation which we extended to all the staff.

A copy of the Minutes of the Evidence taken is annexed.

We have now the honour to make our report to the Secretary of State.

Taking the members of the staff whose appointments are affected in the order in which we heard them, we will state our conclusion on each case.

1. *Mr. Reilly, Demonstrator in the Laboratory.*— This gentleman's name was not before us when we made our recommendations in July 1900. His appointment is of a subordinate character, and it was not necessary to consult us, as his retention or removal should rest solely with the President. We may remark, for the information of the Secretary of State, that Mr. Reilly has two distinct functions. As Demonstrator he takes classes of students and explains the methods of testing metals to them in the laboratory. As an assistant in the laboratory he takes part in the work of testing commercial samples, principally for Indian Railways. At Cooper's Hill there is a laboratory in which testing is done and a workshop in which students are taught mechanical work. It is proposed to unite these two branches of work in one building as a measure of convenience and economy. Mr. Reilly contends that this proposal is inexpedient, and that, if it be carried out, he should be retained in preference to the superintendent of the workshop. Mr. Reilly was originally appointed on a salary of 75*l.* a year, which was subsequently raised to 150*l.* a year with a share in the testing fees. His services have not been continuous. In 1888 he left the College for an appointment under a railway company in India. After 2½ years he returned to England, and was again admitted to the laboratory. At his own request his new engagement was made subject to one month's notice, as he wished to be free to take any better employment that might offer itself. We consider he has no claim upon the Government, and the gratuity proposed to be given to him is an act of grace.

Minutes of Evidence, pp. 13–17.

2. *Mr. Hurst, the Lecturer in Accounts.*—This gentleman is a retired War Office official, 72 years of age. He has been employed on a verbal engagement for the last 20 years to deliver 15 lectures annually, and has been paid at the rate of 5*l.* 5*s.* for each lecture. His lectures are on English Commercial Accounts, and he stated that 15 lectures annually was an insufficient number to teach this subject efficiently. As the time given to

Minutes of Evidence, pp. 17–21.

accounts must, in view of other requirements, be reduced, and as Cooper's Hill is maintained for the Indian Public Works Service, we think that it would be more reasonable to instruct the students in the system of accounts which obtains in the Public Works Department of India, and that, as we have already recommended, a teacher experienced in that system should be employed in lieu of Mr. Hurst. Mr. Hurst enjoys a pension from the War Office, and, considering the slight nature of his connection with Cooper's Hill, we cannot advise the Secretary of State to give him larger compensation for his retirement than has, we understand, been proposed.

Minutes of Evidence, pp. 21–30.

3. *Mr. T. Shields.*—This gentleman was originally engaged as Demonstrator in Physics under Mr. Stocker. When it was decided, on the recommendation of the Board of Visitors, to improve the instruction in electricity and electrical engineering, Mr. Shields was appointed at the instance of Colonel Pennycuick, the late President, to teach electrical engineering, and his salary was raised from 250*l.* to 400*l.* a year. When his name was first put forward for this new duty, we felt a doubt of his fitness, as we were not satisfied that Mr. Shields had the practical experience which we considered a necessary qualification in a teacher of electrical engineering. Serious complaints have been received from India regarding the training in electricity of the College students. We have attached to this report some

See Appendix 12.

papers received from the Government of India, and indicating some of the reasons which led us to the conclusion that this department of Cooper's Hill required reform. We have endeavoured to ascertain from Mr. Stocker and Mr. Shields on whom rests the responsibility for instructing the students, especially the Telegraph Department candidates, in the practical part of the subject. Mr. Stocker, as Professor of Physics and Mr. Shields' superior, is theoretically responsible, but he does not claim practical acquaintance with electric technology. Such instruction as is afforded is given by Mr. Shields, but he appears, to limit his responsibility to Electricity as a branch of Physics. We have recommended that Electrical Engineering should be made a compulsory subject for all students during their whole course, and that it should be made more prominent and be more efficiently taught. At present no doubt some instruction in Electricity as a branch of Physics is given to all the students during their first two years, but practical instruction in Electrical Engineering is only for the third year men, and even in their case is optional. Without questioning his qualifications as a Demonstrator of Physics, we do not consider Mr. Shields has those specially required for the post of Principal Instructor in Electric Technology, and therefore we cannot recommend his retention. After considering his comparatively short service and the conditions of his appointment, we think that the

gratuity proposed in his case is sufficiently liberal.

4. *Mr. Stocker* is Professor of Physics. His ability to instruct in the subject for which he was engaged is undoubted. The arrangement we contemplated was the appointment of a resident lecturer who would take both electric technology and physics, and whose teaching would be supplemented by the services of the best outside lecturers obtainable from London. In these circumstances Mr. Stocker's retention at first appeared to us to be unnecessary. There is this to be remembered, however, that the instruction in physics, which has hitherto been restricted to the men of the first two years, will under our proposals be extended to the third-year students. Considering the additional work thus entailed, and the requirements of the Forest Department, and in view of the probability that the teacher of electrical engineering may find his time fully taken up by that subject, we are of the opinion, in which we believe Colonel Ottley concurs, that it is advisable to retain Mr. Stocker, at any rate until more experience has been gained of the requirements of the case. It must, however, be understood that he can no longer be regarded as the head of that department of the College which includes electric technology. He should take up such position in relation to the teacher of electricity as the President may assign to him.

Minutes of Evidence, pp. 30–36.

5. *Mr. McLeod.*—Mr. McLeod is Professor of Chemistry and is recognised as an eminent chemist. Our reason for recommending his retirement is that the time now devoted to the teaching of chemistry must be curtailed. In connection with this view Mr. McLeod informed us that he believes that in the curriculum for the Mechanical Science Tripos at Cambridge very little chemistry is included. Enquiries show that twice as much time has hitherto been devoted to chemistry at Cooper's Hill as at the principal technical colleges attached to the University of London. We do not deny that for an engineer a good training in chemistry may be a very useful adjunct, but looking to the time at the disposal of the College authorities in a three-year course, and the quantity of necessary work which the students must get through if they are to qualify as engineers, we consider that they have no time to devote to the acquisition of complete scientific knowledge in branches not essential to their profession. For these reasons we hold that the time given to chemistry must be reduced if physics and electricity are to be properly taught, and that two instructors in chemistry are not needed. For the forest students, a course of organic chemistry is required. Mr. McLeod does not wish to undertake that subject, and for that reason, and also for the sake of economy, we recommend his retire-

Minutes of Evidence, pp. 36–41.

ment and Dr. Matthews' retention. Mr. McLeod recognises the fitness of Dr. Matthews, who has assured us that the proposed duties are not more than he can satisfactorily perform. We wish to record our opinion that Mr. McLeod by his able and long services has merited every consideration that can be shown to him by the Secretary of State for India in the matter of his retiring pension.

Minutes of Evidence, pp. 41–47.

6. *Mr. Hearson.*—This gentleman has held his appointment for 16½ years. We desire to explain that the engineering branch of the College teaching requires, in our opinion, to be remodelled, the present arrangements being cumbrous and wasteful. There are a Professor of Engineering, a Professor of Hydraulic Engineering and Applied Mechanics, and a Professor or Assistant Professor of Descriptive Engineering, which we understand to mean the practice of engineering so far as it can be taught without reference to mathematics.

These three teachers appear to have worked more or less independently of each other, and there is no one at the head of the branch who is responsible for co-ordinating the teaching and seeing that a complete education is given. For these reasons we recommended before, and we now recommend again, that the instruction of the students in engineering should be in the hands of one man with suitable assistance, and we are of opinion that to carry out this plan Mr. Hearson's retirement is necessary. We have heard all that Mr. Hearson has to urge against the proposed changes in the Engineering Department. He considers them impracticable. On the other hand, Dr. Brightmore and Mr. Woods have told us that they see no difficulty in fulfilling the duties allotted to them under the proposed new regulations.

Vide Appendix 10.

We note that Mr. Hearson himself, in a letter dated 29th March 1899, which he submitted through the then President (Colonel Pennycuick) to the Secretary of State, recommended the reorganisation of this Department of the College on lines similar to those we have adopted. The main difference between his proposal and our recommendations, apart from the higher title and position which he proposed to give to the second man, is that he then suggested his own appointment as Chief Professor, whereas we consider Dr. Brightmore to be more suitable for the post. We had no desire to institute a comparison unfavourable to Mr. Hearson, whose abilities and scientific standing are undoubted; but as we are compelled by Mr. Hearson himself to refer to the respective merits of these two gentlemen, we must say that Dr. Brightmore's practical experience on large works, in addition to his distinguished scientific career, gives him a superior claim, and we do not consider Mr. Hearson, under all the circumstances, to be the proper person to be the responsible head of the engineering branch of the College. In this latter

opinion we have also the support of the late President Colonel Pennycuick, who, in submitting to the Secretary of State the suggestions of Mr. Hearson to which we have referred above, recorded his opinion that, although he approved of the principle of Mr. Hearson's proposals and thought they must ultimately be adopted, yet they could not be brought into operation until the time arrived for Professor Hearson's own retirement, and in any case he would not support that portion of the proposal which was personal to Professor Hearson himself.

The reasons for Mr. Hearson's retirement are to be found in the re-organisation of the engineering teaching. Mr. Hearson, we understand, is not entitled to a pension, but it is proposed by the Secretary of State to give him a retiring allowance of 150*l.* per annum, and a gratuity of 165*l.* In view of his age, which is 52, and of his position and the sudden diminution of his income, some of us would be glad if the Secretary of State could see his way to increase the amount of his retiring allowance. This suggestion is made with knowledge of the letter written by Mr. Hearson to which reference is made below.

7. *Mr. Heath.*—Mr. Heath's case is the last. Mr. Heath is designated Assistant Professor of Engineering. Prior to his engagement at Cooper's Hill in August 1875, he was employed as an Assistant Engineer on the Great Northern Railway, and no doubt in that capacity acquired some practical experience. We understand his lectures to have been confined to what is called, at Cooper's Hill, Descriptive Engineering, *i.e.*, the practice of engineering so far as it can be taught without mathematics.

Minutes of Evidence, pp. 47–49.

Under the proposals for remodelling the study of engineering, the instruction in the subject as a whole is to be carried out under one Professor with an assistant, on whom will devolve work which requires considerable mathematical attainments, and for which, in our opinion, another member of the existing staff is better fitted. For these and other reasons into which we need not enter, we are of opinion that there are no grounds for departing from our former conclusion, and we recommend Mr. Heath's retirement. We understand that he will be entitled to a pension of 273*l.* 9*s.* 9*d.* per annum, which, in our opinion, is sufficient.

Our purpose in summoning the Professors in Mathematics, Messrs. Minchin and Lodge, was to ascertain whether the proposals made by Colonel Ottley and approved by us, to give more time to mathematics generally, to extend the teaching of this subject to men in their third year, and to give the teaching more of a tutorial character, were in accordance with the views of the mathematical professors. It is plain, we think, from Professor Minchin's evidence that the only issue between him and Colonel Ottley is on a question of fact, namely, whether the teaching hitherto has been

Minutes of Evidence, pp. 67–81.

open to the objection taken by Colonel Ottley, that it is mainly a system of lecturing to large classes. We think it is unnecessary to enlarge on this issue. It is enough to say that if the classes have been enlarged and the number of lectures reduced, the responsibility does not lie on the mathematical professors. Owing to the introduction of other subjects, the hours given to mathematics have been from time to time reduced. It was attempted to remedy this by giving a course of lectures in the evening. Professor Minchin describes how this plan failed. The fact remains that the classes are now too large, averaging about 40 men, to admit of individual teaching. As to the principle to be adopted, namely, the division of the students into small classes, which will admit of a considerable admixture of individual teaching, the mathematical professors are at one with Colonel Ottley. So also in respect of the extension of the teaching of applied mathematics to the third-year men. We have every confidence in the tried ability and zeal of Messrs Minchin and Lodge, and we can leave the matter safely in the hands of the President in consultation with them.

That the requisite time required for teaching mathematics can be given by Professors Minchin and Lodge without additional assistance is clear from their statements. The proposal to appoint two instructors to aid the professors is unnecessary, and in fact it was withdrawn, we have ascertained, by Colonel Ottley himself so far back as November 1900.

Sir William Anson has said that many persons eminent in science have expressed a strong opinion that the proposed dismissals will act injuriously on the scientific education of the country.

We desire to remark that the changes proposed in no way impair the teaching of science in Cooper's Hill. Science teaching has always received the earnest attention of the Board of Visitors, and its progress has been encouraged and recommended by us.

The relations between the President and the Staff were not placed directly before us in the institution of the present enquiry. But in the course of the evidence, the very unsatisfactory state in which matters stand, and have stood, we fear, for some time past, has been forced upon our attention. We think it only fair to Colonel Ottley to say that he appears to have had from the first a very difficult task. It will be seen from the evidence that Colonel Ottley's predecessor, Colonel J. Pennycuick, after resigning the Presidentship, and either before he made over charge or immediately after vacating his post, wrote a letter to a newspaper accusing the Secretary of State for India of committing "scandalous injustice" in the appointment of Dr. Brightmore, and declaring the unfitness of that gentleman for his post. This letter was, at Colonel Pennycuick's suggestion, as we are informed

Minutes of Evidence, pp. 82–84.

Appendix 13.

by the witnesses, published in the College Magazine, which is edited by two members of the College Staff and is in the hands of all the students. The effect on the students may be readily conceived. It is right, also, to draw attention to the letter, dated 12th March, published by Mr. Hearson in the paper called "The Engineer" of the 15th March, while this enquiry was pending, which letter appears to have been written by Mr. Hearson after he knew the enquiry was to be held. After every allowance is made for the feelings of a man smarting under a sense of what he believed unjust treatment, the publication of this letter and the expressions contained in it deserve condemnation. Attention may be drawn also to the correspondence between Dr. Brightmore and Mr. Heath and Colonel Ottley. We are not sure whether the communications between Colonel Ottley and his subordinates on matters concerning the College curriculum have been as free and cordial as they should have been. But seeing the difficulties thrown in ColonelOttley's way, we are not prepared to blame him, and we believe that he is quite ready to do all that in him lies to remove the cause of friction.

Appendix 14.

Appendix 11.

Colonel Ottley has come forward on this opportunity to express his regret at the abruptness with which the notice of the Secretary of State's decision to dispense with their services was communicated to the gentlemen concerned, and he has explained how it was caused. We are convinced that no one can regret this incident, which was unintentional on his part, more than Colonel Ottley.

Minutes of Evidence, pp. 51-60.

C. H. T. CROSTHWAITE.
W. S. S. BISSET.
J. WOLFE BARRY.
A. M. RENDEL.
C. P. ILBERT.
W. H. PREECE.
HUGH LEONARD.
J. MANSERGH.

(Col. G. F. Pearson was unable to attend.)

25th March 1901.

EAST INDIA (ROYAL INDIAN ENGINEERING COLLEGE).

LIBRARY OF THE BOMBAY BRANCH OF THE ROYAL ASIATIC SOCIETY

MINUTES OF EVIDENCE

TAKEN BEFORE THE

BOARD OF VISITORS AT THE INDIA OFFICE,

ON

Thursday, 14th March 1901,

IN REFERENCE TO THE

Remodelling of the Studies and the Retirement of certain of the Professors and Lecturers.

Present:

SIR CHARLES H. T. CROSTHWAITE, K.C.S.I., Chairman.
SIR JOHN WOLFE BARRY, K.C.B., F.R.S.
MR. HUGH LEONARD, F.S.A.
MR. JAMES MANSERGH.
SIR W. H. PREECE, K.C.B., F.R.S.
SIR W. S. S. BISSET, K.C.I.E., R.E.
SIR ALEXANDER M. RENDEL, K.C.I.E.
SIR COURTENAY P. ILBERT, K.C.S.I.

Mr. P. REILLY called and examined.

Mr. P. Reilly.

1. *Chairman.* You are 40 years of age, I believe?—*A.* I am.
2. You were appointed to the College on the 26th September 1884?—*A.* Yes.
3. Have you served ever since?—*A.* I have, except that I was away for three years.
4. You were away, I think, from January 1888, to August 1890?—*A.* Yes.
5. That is, you were away from the College over two years and a half?—*A.* Yes.
6. Were you on Government duty then?—*A.* For nearly one year I was on the Bengal and Nagpur Railway.
7. In the Indian service?—*A.* Yes.
8. In what capacity?—*A.* As assistant engineer.
9. In what capacity were you appointed to the College in September 1884?—*A.* I was appointed Mechanical Laboratory Demonstrator.
10. Do you hold the same appointment still?—*A.* The appointment has been increased since then. At that time I was only receiving 75*l.* a year, and then my duties were to superintend the mechanical laboratory class under Professor Hearson, and also to test a small number of commercial samples. Shortly, the number of commercial samples became very much

Mr. P. Reilly.

greater, and Sir Alexander Taylor then recommended that my pay should be doubled. I believe he was backed up by Sir Alexander Rendel in that, and it was subsequently granted by the Secretary of State for India. I was then told that my duties would be to superintend the mechanical laboratory class as before and also to test up to 1,000 samples for 150*l.* a year, but after 1,000 samples I was to receive 40 per cent. of the testing charge on the remainder. This they estimated would bring me in another 50*l.* a year; but I may say that during the 13 years that it has been going on the total sum brought in has been 54*l.* 12*s.*, so that I have not scored very much over that.

11. That sample business, I take it, was quite distinct from the teaching; there was no teaching connected with it?—*A.* There was the usual class.

12. You had the usual class, but the testing of the commercial samples was an entirely different business; I mean it was in no way connected with the teaching?—*A.* No, but it brings in the revenue.

13. I am not talking of that; I mean you cannot call it tutorial duty?—*A.* No, I only claim that part of my time was spent on it.

14. How much of your time was actually occupied in teaching?—*A.* I have classes for four days a week for about three to four hours a day. I have six small classes—I take them with about four to six men.

15. In the laboratory, do you mean?—*A.* Yes, in the laboratory; I go through a course of testing with them.

16. To show how it is done?—*A.* Yes.

17 In reference to the break of service when you went away for two and a half years, I suppose that was at your own request?—*A.* Yes.

18. Can you tell me the terms on which you took the employment at the College?—*A.* The first time the terms were three months' notice on either side. On returning again I came in temporarily to take Mr. Carus Wilson's work up for him. After finishing that, Sir Alexander Taylor invited me to again take on the work with him. I had been promised foreign work abroad, and the engineer I was going out for, Mr. Livesey, advised me to get the terms altered, if possible, to one month's notice instead of three, as he said it would be impossible for engineers to wait three months, and if there should be foreign work turning up that I wanted I must get the notice altered.

19. Therefore it was altered, at your own request, to one month?—*A.* Yes.

20. To suit your own convenience?—*A.* Yes.

21. It appears now that it has been recommended that the laboratory and the workshops should be brought into one building; perhaps you would explain to the Board how it is worked at present.—*A.* The mechanical laboratory has got its own machinery and its own staff, its work being to do the small amount of teaching that is done there, and mainly the testing of Sir Alexander Rendel's work—that is the large part of the work that is done there.

22. Do you mean that the main part of the testing is done in the laboratory?—*A.* It is entirely done in the laboratory.

23. Then there is the workshop?—*A.* The workshop proper is for instructing students in workshop work.

24. In ordinary mechanical workshop work?—*A.* Yes. The mechanical laboratory machinery is only used by the professional workers; the testing machinery is, of course, used by the students.

25. As I understand, if they were brought into one building an economy in the staff and in the expense of the two would be possible?—*A.* That is a matter of opinion. It is not my opinion. My opinion is that I cannot do with less than three men to carry out my work; and I am sure they cannot do with less than two in the workshop; two and a labourer is all that they have got.

26. Is there another gentleman in the workshop, then?—*A.* There is a superintendent and an assistant, and I think they take up to 20 or 22 men to superintend at actual mechanical work in the shop.

27. Do you think that one man could do both the works?—*A.* I do not think so.

28. Apart from the testing, or if there was not much testing, could one man do it?—*A.* I do not see how he could possibly do it, because he would have to be in two or three places at once.

29. Even if they were brought into one building?—*A.* Yes; but it would be a very big building.

30. And you do not think it could be done?—*A.* In my opinion it could not; not satisfactorily. Furthermore, the workshop superintendent Mr. Hopps takes my place when I am away for a holiday. I may tell you that I only got five weeks in the year for holiday; three weeks in the summer, and one week each at Christmas and Easter; and the workshop superintendent then takes my place for the commercial testing. As far as I know, he is the only other man in the place competent to do it.

31. Then you think that even by joining the two together, it does not become possible to put the whole thing under one man?—*A.* I think it is not possible unless you give him more assistance. A man could superintend the work if he is not going to do anything else, but certainly somebody would be wanted in my place; whether it is myself or somebody else is not of very great importance.

32. Supposing there was no testing done at all for outside work, that is, supposing no commercial samples were tested, then do you not think one man could do it?—*A.* To begin with, I do not think Mr. Hopps is competent to do the teaching for the students' part of the subject as well as his present work.

33–34. I was not making it a personal question at all. I was putting it to you, could one man, supposing him to be competent, do it, or could he not?—*A.* I should say not.

35. Not even if there was no testing?—*A.* No.

36. Does Mr. Hopps, the second man, now do any teaching?—*A.* He teaches in the workshop, the practical work.

37. *Sir Alexander Rendel.* What class of man is he? Is he a working man?—*A.* Yes.

38. Of the foreman class?—*A.* Yes.

39. *Chairman.* Have you any further criticisms to offer on that proposal of uniting the two into one building? You have told us that you do not think it is a good plan, and that you do not think one man could do the work; have you any other objection to raise to it?—*A.* I do not think that any economy could result from it. We are working at present with a moderately small engine, which is only run when it is wanted; but in that case we should have to use a big engine for doing a very small amount of work for a large part of the year, and there would be an enormous cost in shifting the testing machine, which weighs over 20 tons.

40. That is to say, to shift it in the first place.—*A.* To shift it from one laboratory to the other.

41. That is if the two were put into one building?—*A.* Yes.

42. As to your personal case, supposing that the Secretary of State decides to work it upon this new plan, and to keep only one man, have you anything to urge against your receiving one month's notice and retiring?—*A.* On the terms of my agreement I can hardly object to it. I might possibly think that I should be rather hardly treated, though.

43. Will you explain why you would be hardly treated? As you have gone away when you liked yourself, and as you of your own accord asked to have your term of notice reduced to one month when it suited your own convenience, will you say why you consider it is so hard that the other party to the agreement should want to carry it out?—*A.* I have put in nine years' service with the Indian Government, and I am not entitled to any pension; but I think I am entitled to some consideration on being turned out of my post.

44. You have put in nine years' service, but it was not continuous service, was it?—*A.* The last nine years have been; indeed it is more, it is nearly 11 years, as I came back in 1890.

45. You left it in 1888?—*A.* Yes.

46. Of your own wish?—*A.* Of my own wish.

47. And you came back in 1890?—*A.* Yes.

48. Of your own wish?—*A.* I did.

49. And of your own wish turned it into what is practically temporary terms, namely, one month's notice?—

Mr. P. Reilly.

50. *Sir William Bisset*—You spoke of the large workshops. At present there are two workshops, I think; that is to say, two buildings separated by about 100 yards; is not that so?—*A.* Somewhere about that.

51. What is the size of them; you spoke of their being large, as far as my recollection goes?—*A.* The workshop of the mechanical laboratory, I should say, is about 100 feet by about 50 feet, and the workshop proper is probably 150 feet by 50 feet.

52. The machines in the one are to some extent duplicates of the machines in the other, are they not, although they use the ones for testing, and the others for educational purposes?—*A.* Only in one case, I think. In the mechanical laboratory we have a milling machine, a lathe, a slotting machine, and a drilling machine which are used for cutting out samples for testing purposes. In the workshops we have several lathes, planing machines, and other machines for the use of the students.

53. *Sir Alexander Rendel.* What time are you engaged in absolute teaching?—*A.* About three or four hours a day. Four days a week during about three months.

54. Do you agree to this, that you are engaged "about three hours at the time for 40 or 50 attendances in the year, say, 150 hours a year"?—*A.* On educational work?

55. On teaching?—*A.* Rather more than that, I should think, but not much.

56. Taking the year all through, and taking 300 days to the year, would you say that it was something more than an hour a day?—*A.* It would amount to that in the average.

57. That is at teaching; and the rest of your work is attending to the commercial part of the business, is it not?—*A.* Attending to the commercial testing.

58. For which you receive how much a year extra?—*A.* It was all lumped together into one grant. I receive 150*l.* a year for doing the whole of it.

59. You mean that you receive 150*l.* a year for teaching?—*A.* No, for doing the whole of the work.

60. But *plus* something after you get more than a certain number of samples?—*A.* *Plus* 40 per cent. of the testing cases then.

61. And that comes to about 54*l.* a year did you say?—*A.* I beg your pardon, it has amounted to 54*l.* 12*s.* in 13 years.

62. *Mr. Mansergh.* 4*l.* a year?—*A.* Yes.

63. *Chairman.*—Were you getting the testing fees before, or when did you begin to get the testing fees?—*A.* I was promised the testing fees in 1887. The conditions were that I took charge of the laboratory class as before, and that I carried out the testing work on 1000 samples a year, after which I was to receive 40 per cent. of the testing fee on all additional samples tested.

64. And during the whole of the time you only got that 54*l.*?—*A.* During the whole of the time I have been there I have had 54*l.* 12*s.*

65. *Sir Alexander Rendel.* How many hours a day were you occupied in testing?—*A.* That depends very largely upon the number of samples we get.

66. Quite so; I understand that it varies immensely?—*A.* You may take it that with testing, booking, and writing up accounts, it runs to about three samples per hour.

67. How many hours in the year would you be occupied? How many tests did you make in a year?—*A.* I cannot tell you exactly as I have not got my notes of that. Roughly, if we got the 1,000 which were promised—and I do not have anything until we have done that—it would be about 330 or 340 hours' work.

68. Say 350 hours per annum, that is rather more than another hour per day?—*A.* Yes.

69. Would it be fair to say that you were employed on the business of Cooper's Hill 2½ hours a day throughout the year on the average, taking 300 days to the year?—*A.* I daresay that would be about correct; but I have got to be there whether I am doing anything or not. That is the unfortunate part of it—I cannot do anything else.

Mr. P. Reilly.

70. The absolute work that you are doing at Cooper's Hill would be represented by 2½ hours per day, for 300 days in the year; that would be roughly what you did?—*A.* Yes, I think probably it would, taking every day.

71. Had you any rooms in the College?—*A.* I have rooms in the College, but I have to pay for them.

72. And you get nothing you do not pay for?—*A.* No.

73. *Chairman.* You do not get board?—*A.* No, only by paying for it.

74. In what capacity did you serve the Bengal and Nagpur Railway?—*A.* I was assistant engineer under Mr. Way; the district engineer was Mr. Birkett.

75. *Sir Alexander Rendel.* What were you doing?—*A.* I went out on the construction staff. Mr. Wynne was the chief engineer.

76. Did you leave Cooper's Hill to go with Mr. Wynne?—*A.* Yes.

77. You were one of that body?—*A.* I was one of the first lot that went out.

78. Then you were a Cooper's Hill student, I take it?—*A.* No, I was not a Cooper's Hill student, but I have lived at Cooper's Hill most of my life.

79. *Sir William Bisset.* Did you leave the Bengal and Nagpur on the completion of the construction?—*A.* No, through ill health. I got a sunstroke, and was sent home.

80. *Mr. Mansergh.* Did I understand you correctly that you had nothing to do with the workshop?—*A.* Nothing at all.

81. *Sir John Wolfe Barry.*—Would you make it quite clear what is the work going on in the one building, and what is the work going on in the other, so far as teaching is concerned?—*A.* The work in the workshop is to teach the men the work that mechanics do, it is purely mechanical work.

82. You teach them the use of tools?—*A.* They are taught to use hand and machine tools. In the mechanical laboratory, they learn the use of testing machinery and are given instruction in testing different kinds of materials used in construction.

83. Do the students go into the testing room, as well as into the other room?—*A.* Yes.

84. They have access to both rooms?—*A.* Yes.

85. Sir Alexander spoke to you of 300 days in the year; but 300 is not the number of days in the three terms, of course?—*A.* No.

86. The number of days in the three terms comes to about two-thirds of that number, I suppose?—*A.* About that; but as far as Sir Alexander Rendel's testing goes, that continues all through the year.

87. *Chairman.* I understand that you are teaching about 40 or 50 days in the year?—*A.* I am teaching for 50 days quite.

88. And when you are teaching you do about three hours a day?—*A.* Three to four.

89. *Sir Courtenay Ilbert.* What was your experience before you went to Cooper's Hill in 1884?—*A.* I had been a pupil of my father's, who was Senior Professor at Cooper's Hill, he was with Mr. Edward Woods before he went to Cooper's Hill. I served in my brother's office after leaving there.

90. What was your brother?—*A.* He was a consulting engineer and was occupied chiefly with the design of constructional ironwork in connection with buildings, such as roofs.

91. Were you a pupil of your father's at Cooper's Hill?—*A.* Yes.

92. Had you had any teaching experience before you went there?—*A.* No.

The witness withdrew.

Mr. J. C. Hurst.

Mr. J. C. Hurst called and examined.

93. *Chairman.* Are you 72 years of age?—*A.* I am. Lord George, to my detriment, said I was 75. I am putting up for a local post down where I live, in connection with the district council; and my opponents twit me now, and say I am 75 years old and no good. That is only in passing.

94. The date of your appointment was February 1881, do you remember?—*A.* I do not remember it, but it is nearly 20 years ago, I know.

95. That is the office record.—*A.* That is sure to be right.

96. I think you were formerly in the War Office?—*A.* I was.

Mr. J. C. Hurst.

97. In the Accountant-General's Department, I understand?—*A.* I was the Accountant and Auditor to the War Office.

98. You were a long time in the War Office, I think?—*A.* I was there nearly 40 years.

99. When you left the War Office, of course you left with a pension?—*A.* I did.

100. Was it then that you went to Cooper's Hill?—*A.* No. I left the War Office because I was obliged to leave at 65—that is seven years ago. I have held the Cooper's Hill appointment for nearly 20 years.

101. You held the Cooper's Hill appointment in addition?—*A.* I used to take my Cooper's Hill days out of my holidays, with the Secretary of State's approval.

102. Can you tell me the terms of your engagement at Cooper's Hill?—*A.* I was to give 15 lectures at five guineas a lecture.

103. Was any time fixed for the lectures, or was the President left to fix them?—*A.* No time whatever was fixed. The first President was Sir Alexander Taylor, who very kindly asked me what time would be convenient, and he met my convenience very nicely. It has been altered at least on two or three occasions, to suit other arrangements in the College.

104. So that you have gone and lectured at the College. Were all those fifteen times lectures?—*A.* They were all lectures.

105. I thought that there were actually 13 lectures and one preliminary examination which counted as two lectures?—*A.* It does not do to make use of strong expressions, but I assure you that is an absolute untruth.

106. Which is?—*A.* The one you have just referred to.

107. It is not of any importance really.—*A.* It is of great importance to me that I should be charged with taking the money for 15 lectures and only giving 13.

108. I thought it was understood that for the examination you should get paid as for giving two lectures?—*A.* No. There was some talk about it originally, but I said, "No, 13 lectures will not do justice to my subject, and I must give 15." The outside examiner who conducts the final examination is paid ten guineas. I gave that up, and I said, "No, I will give my 15 lectures, because I cannot do the subject justice without doing so."

109. You give 15 lectures and you are paid five guineas a lecture?—*A.* Yes.

110. The course at Cooper's Hill for the students is a three years' course, is it not?—*A.* It is.

111. Are we to understand that each student gets 15 lectures a year during his whole course, or that he only gets one course of 15?—*A.* I only take them in the third year, and then they have 15 lectures in two terms.

112. So each man gets his 15 lectures?—*A.* Each one does.

113. What do you lecture them in—on accounts?—*A.* On commercial accounts. May I say that I followed the course which Sir George Chesney introduced. He used to conduct these lectures himself, and I took up his old papers that he had there to guide me. I have since seen Sir George Chesney on his return from India, and I have told him that I have been carrying on his course. He then explained to me that the reason he did that was, that it was no use teaching them purely and simply accounts based upon the Indian practice, because only a moiety of the men went to India, but by teaching them on the commercial system, they could apply their knowledge to accounts wherever they went. Sir George Kellner, who was an old friend of mine and who was an eminent accountant of India, made that a speciality of his; he also considered that that was the best system to adopt.

114. When you were appointed, were any terms fixed; were you to be a permanent member of the staff?—*A.* I had nothing written whatever. I saw Sir Alexander Taylor when he gave me this appointment. He said they had been trying to get a lecturer on accounts. "We have offered it to Sir George "Kellner, who has declined to undertake it, and I have been recommended "to apply to you." I said to him and also to the Secretary, "Is this to be an annual appointment?" and he said, "No; as long as you do the work you will have the appointment," Those are the only terms that I had. I had nothing in writing.

115. *Sir William Bisset.* You speak of the arrangements for the course of lectures having been made in communication with Sir George Chesney; have you had any representations in the past that the course was not exactly what was wanted by the people in India?—*A.* Not one word.

116. There have been representations to that effect.—*A.* Not to me.

117. Then you have made no changes in the course of your instruction for the last 20 years?—*A.* No, I have made no change for the simple reason that I think I was justified in believing that what I was doing was satisfactory to everyone, because I never heard one single adverse syllable on the subject. On the contrary, I have had several letters, extracts from which I have sent to the India Office, from Sir Alexander Taylor, saying that he was rather surprised than otherwise that I had been so successful.

118. In the absence of these representations, it is rather difficult perhaps to pursue the subject, but looking over what has been put forward here as the accounts course and the exercises which are gone through, I have before me examination papers and exercises, I confess that they are not such as I would personally desire to have the officers educated in.—*A.* The officers who went to India do you mean?

119. Yes; these exercises appear to be so purely accounts of mercantile transactions.—*A.* They are.

120. And so little accounts which engineers have any reason to keep.—*A.* May I mention that one plan that I adopt is to tell all of them, on the construction, we will say, of a State railway, exactly what accounts they will have to keep when they go to India, and how to apply my system to the Indian system. Of course in building bridges there are certain accounts which have to be kept; the expenditure has to be kept under certain heads of course; the same heads of service, I apprehend, under which the money is provided, so as to compare the expenditure with the estimate, or with the money authorised. I explain that to them always. What I venture to say is, that they are able to apply the English system, the commercial system that I teach them, to any accounts that might be placed before them.

121. Do you think that in this course of 15 lectures you teach them to keep accounts?—*A.* I examined my men the other day in a preliminary examination, and I say that one-third of those men can take up any accounts in India. Of course, I do not mean that I can put one of these young men into an office and tell him, without seeing any of the previous accounts, to keep them and initiate them himself; I do not mean that, but I do mean to say that they are competent to take up accounts which already exist, and to understand what they are doing.

122. In all these accounts I do not see any reference, except in one instance, to a railway contractor's account and in another to an executive engineer's account; all the rest are book-keeping matters.—*A.* Yes.

123. They are hardly what I would call the engineer's side of account keeping.—*A.* No, of course I admit that.

124. They seem adapted rather to the professional accountant's side than to the engineer's side of it.—*A.* I quite see that. If any suggestion had ever been made to me that I should extend it a little farther in the direction that you are now alluding to, I would have done so; but in the absence of any complaint I had nothing to guide me in thinking that I was not giving perfect satisfaction.

125. *Chairman.* What complaint have you as to being asked to retire?—*A.* Might I continue one or two other statements about the teaching?

126. Certainly.—*A.* I was going to say that I have seen many students who have returned during my twenty years' connection with the College, and they all told me that my lectures on accounts had been of the greatest assistance to them. I would like also to mention that Major Stuart, who attended my lectures and who was General Courtney's Assistant for some time, asked me to be allowed to attend my lectures. He did so, and he did very well indeed. I met him the other day with Colonel Pennycuick, who was the previous President. Colonel Pennycuick has a great horror of accounts, I believe, and I think his idea is that they are no use at all. I said to him, "Well, Stuart, how do you get on with the accounts; were my lectures of any use to you?" He said, "I will tell you," and he told this to

Mr. J. C. Hurst.

Colonel Pennycuick too: "I was enabled to discover a fraud being perpetrated by a pay-sergeant at Chatham entirely from the knowledge that I obtained from your lectures," and, mind you, I only gave him lectures on the same basis, that is, on the commercial system of accounts.

127. Did you ever examine the Indian system of Public Works Accounts, and make yourself familiar with it?—*A.* I have seen the whole of them. I have statements that were published by the Indian Government containing sets of accounts of all kinds. It is from those publications that I was enabled to tell my students the accounts they should keep under various circumstances in India.

128. *Sir Alexander Rendel.* In what did your tuition consist, did it consist simply of lecturing?—*A.* Lecturing, and I might say I had to go amongst them. I attended to the wants of any students who wanted to ask questions. Originally, when I commenced, and when I had only 25 or 27 students, I was able to give individual attention to each man, and to see what he was really doing, and, if he was doing wrong, to put him right, more as a tutor perhaps than as a lecturer. I carried that out. But I had 42 men this last time, and I found it very difficult, because if I only gave two minutes to each man, then 84 minutes out of my time for lecturing was gone.

129. What was the limit of time?—*A.* Two hours was my time, which I found little enough. My plan was to lecture to them for about an hour and a half, and to devote the other half-hour to answering any questions that might have arisen in their minds.

130. Did you keep one set of lectures and deliver those same lectures year after year?—*A.* I used to add to them occasionally.

131. But the stock and lock were the same?—*A.* As a rule they were very similar.

132. *Sir William Preece.* I gather from what you said that you were never told by Colonel Pennycuick when he was President that a report had been sent him from India condemning the system of teaching accounts and advising the abolition of the course.—*A.* Never.

133. But such a report did come?—*A.* He never told me; in fact, I may say that no one has told me of it, and I never heard one single syllable of it until I got the notice from the India Office dismissing me.

134. *Mr. Mansergh.* Did the students keep any books?—*A.* Yes, and they are all procurable, all their books are there.

135. Where they merely note books?—*A.* No, account books, cash book, ledger, journal, and so on.

136. And you occasionally examined what they were doing?—*A.* Yes.

137. *Sir Alexander Rendel.* You gave fifteen lectures in all in the course of the year?—*A.* Yes.

138. *Sir John Wolfe Barry.* I think I understood you to say that you thought fifteen lectures was the minimum number to which you could compress your course?—*A.* I think so.

139. That is quite irrespective of the examinations.—*A.* Quite. When I got so many men—when I got 42 men—I thought that it was too much for one course. I mentioned this to Colonel Pennycuick. He said, "No, you must go on; would you double the lectures for the same fees?" "No," I said, "I could not do that." "Then," he said, "you must go on and make the best of it." I have done so, and it has been very hard work.

140. I presume that your view would be that more time ought to be given to accounts?—*A.* I think so.

141. That is looking to the number of students that are now joining the class?—*A.* Yes, and to the difficulty of getting amongst them individually when there is such a large number.

142. *Sir Alexander Rendel.* Given two years and a quarter to study engineering science, would you give more than 15 lectures on accounts, or would you give none at all?—*A.* That is a question that I could not possibly answer.

143. *Sir John Wolfe Barry.* At any rate, your view is that the amount of time that has been given is certainly none too much?—*A.* It is none too much.

144. Your view rather would be that it ought to be increased?—*A.* It ought to be rather extended than otherwise. Whoever does it, I should think that 20 lectures instead of 15 would be nearer the mark than reducing them, at any rate. *Mr. J. C. Hurst.*

145. Therefore, if it were the view of the governing people of the College that the time given to accounts would have to be reduced, the only way to do it would be to simplify the subjects taught?—*A.* Or to double the lectures, perhaps.

146. Assuming that the time given was considered so much that it ought to be reduced, the only way of teaching accounts at all would be to simplify the course altogether by adopting only one view of the subject, perhaps?—*A.* Yes, perhaps so.

147. *Sir Courtenay Ilbert.* You do not reside at Cooper's Hill, do you?—*A.* No.

148. Where do you reside?—*A.* I removed to Twickenham two or three years ago because I would be nearer Cooper's Hill, and that would make an easier journey of it. I should not have done that if it had not been for Cooper's Hill.

149. You say you teach your pupils to apply your system to the Indian system—those were the words you used, I think?—*A.* Yes. I tell them this exercise is on a purely commercial basis, but I say you can equally apply the system whether you are building a bridge or whether you are selling brandy and wine as a wine merchant; your expenditure has to be kept, and wherever you debit your work, you must credit the person who did it, or the money you paid for it. I have given them the heads of service under which all these accounts should be kept.

150. Then you teach your system, not because it is the best system for those who go to India, but, as I understand, because it is the best for pupils of whom some are to go to India and some are not?—*A.* Quite so; that is exactly my view.

151. It is a compromise between what is best for India and what is best for the pupils?—*A.* Yes, that is exactly the argument I use. I wrote a letter to the India Office, and went into it rather extensively, but the answer I got did not take any notice of that at all.

152. *Chairman.* Supposing we were educating only for India?—*A.* That is another thing.

153. Then it is another question, you say?—*A.* Quite so.

154. *Mr. Mansergh.* Then you would specialise?—*A.* Quite so. If all the students went to India, the Indian system must be the only one you should teach them, decidedly. I have got one or two things I want to bring to your notice, where I think I have suffered an injustice. Does that come under head No. 2, "Personal?"

155. *Chairman.* Yes, if it is in respect of your retirement, and quite apart from anything else.—*A.* It is with respect to the mode in which I have been treated in the matter.

156. We should be glad to hear what you have to say.—*A.* I have just put two or three notes down here. One thing that has been stated is that the professors and lecturers are their own examiners.

157. You are now bringing up statements in Colonel Ottley's Report; I do not think we can go into those.—*A.* I am quite in your hands.

The witness withdrew.

Mr. THOMAS SHIELDS called and examined. *Mr. T Shields.*

158. *Chairman.* You are 33 years of age, I believe?—*A.* Yes.

159. What degrees have you got?—*A.* Master of Arts and Bachelor of Science of Glasgow University. I have also a Certificate of Proficiency in Engineering Science. That is a certificate in Civil Engineering Science, and it is called the Diploma of C.E. in Scotland; it is not known in England.

160. *Sir Courtenay Ilbert.* Is that from the Glasgow University, too?—*A.* Yes.

161. *Chairman.*—When were you appointed to Cooper's Hill?—*A.* In January 1892.

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162. Have you been there continuously ever since ?—*A.* Yes. Might I say that I took my predecessor's work temporarily in the Easter Term of 1891, while he was ill, and of course that was not an India Office appointment.

163. Before that, where were you ?—*A.* Before that I was at the Yorkshire College, Leeds, where I was Lecturer and Demonstrator in Technical Electricity.

164. How long were you there ?—*A.* Quite a short time. I was there from September 1891 to January 1892.

165. In what capacity were you appointed to Cooper's Hill in 1892 ?—*A.* Demonstrator in Physics.

166. After that, in 1897, I believe there was a change ?—*A.* In Session 1896–1897, the alternative electrical course in the third year was increased considerably. It was doubled. That work practically entirely fell on me. Consequently, in the summer of 1897 I applied for an increase in salary, and also for the additional designation of Lecturer in Electrical Engineering; and that was granted me by the Secretary of State in September 1897.

167. Before that, you were not employed in teaching electricity, were you ?—*A.* Yes, at the Yorkshire College, Leeds; also at the University of Glasgow.

168. I mean at Cooper's Hill ?—*A.* Yes, I was.

169. As Demonstrator in Physics did you also teach electricity ?—*A.* Yes. My work as Demonstrator in Physics was nearly entirely electrical.

170. Was there any other teaching of electricity in Cooper's Hill ?—*A.* Professor Stocker gave the Lectures in Physics, which included Lectures on Electricity, the Lectures on Electricity being a large proportion of the total Lectures on Physics.

171. Were they technical or theoretical?—*A.* They were theoretical lectures.

172. And yours ?—*A.* They were technical lectures and practical laboratory work.

173. Can you tell us the terms on which you accepted the appointment ?—*A.* The appointment of Demonstrator in Physics ?

174. Yes, take that. I suppose they are both on the same tenure ?—*A.* I cannot quote them, but they were the usual terms, as far as I know, that have ruled in these appointments.

175. Is this correct, that these appointments were terminable on one term's notice on either side, and that no pension was claimable ?—*A.* I do not think that is an exact quotation, but I should not like to say. The terms, as far as I remember, were that the appointment was during the satisfactory performance of the duties.

176. As long as the President was satisfied with your work ?—*A.* Yes, subject to the proviso of three months' notice.

177. One term's notice on either side ?—*A.* Yes.

178. And no pension ?—*A.* There was no pension attached to the appointment.

179. What remuneration did you get ?—*A.* When I was appointed Demonstrator in Physics, my salary was 250*l.* a year, and an addition was made in September 1897 of 150*l.* a year.

180. That was when you got the additional lecture work ?—*A.* Yes.

181. Did you get a house or quarters ?—*A.* No, I got neither.

182. How many hours a week are you employed in teaching ?—*A.* At present for one half of the year I am employed 32 hours a week teaching and supervising the practical work.

183. First of all, as Demonstrator in Physics, when you had no electrical work or but little electrical work, I suppose the amount of work was less then ?—*A.* Yes.

184. How much was it then, do you know ?—*A.* The work was less then by eight weeks at 15 hours per week approximately.

185. Now you teach for how many hours a week, do you think ?—*A.* For half the year, 17 to 20 hours a week, and for the remaining half, 32 hours a week.

186. *Sir Alexander Rendel.* By "year," do you mean the academic year ?—*A.* Yes.

187. That is about 30 weeks ?—*A.* Yes, exclusive of examinations.

188. *Chairman.* There are three terms ?—*A.* Yes.

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189. How is your work divided with regard to those three terms?—*A.* My work is divided in this way. The alternative course in electricity in the third year runs parallel with other courses, that is to say, it is alternative with what is called turbine design (mechanical design), the chemical laboratory, and architecture. I think you will find it correctly stated in the Blue Book on page 28. The division of my work is brought about in this way—that my alternative course begins with turbine design and goes on to the end of architectural design. It is an accidental division, that is to say, accidental as far as myself is concerned; it depends on the other subjects.

190. What is the turbine design?—*A.* The turbine design is the mechanical engineering design, the machine which is selected for the purpose being the turbine.

191. How does it come into your work?—*A.* It does not come into mine; my work begins with it and runs parallel with it.

192. I understand the Secretary of State has given you notice that he will not require your services after this term?—*A.* Yes.

193. Considering the terms of your appointment, what objection have you to make to that?—*A.* My objection to it is, to begin with, that it is entirely an unusual step to take in connection with an academic appointment.

194. Do you call this an academic appointment?—*A.* Yes.

195. It is an unusual step, you say?—*A.* Yes. It is not a step which one conceived would possibly be taken when I took the appointment. I never conceived that it would at all have been considered a likely step.

196. Although it was one of the terms on which you were engaged?—*A.* Yes. That is quite a usual clause in any of these agreements; and the conventional or the usual reading is that it is put in as a safeguarding clause, so as to provide for a case of intellectual or moral impossibility.

197. Will nothing short of intellectual or moral impossibility suffice?—*A.* Absolute incompetence, of course, would.

198. Nothing short of absolute incompetence? Supposing we were not satisfied with the teaching of a professor; that we did not consider that his teaching was the sort of teaching we want, nor up to the exact standard that we want; would you consider that the whole of the students must continue to suffer from that inadequate teaching, in order to meet the personal interests and views of the professor?—*A.* No.

199. You would not go so far as that?—*A.* No. That, of course is a matter which must be entirely left in the hands of the governing body.

200. Supposing that the governing body think that the professor is not the sort of man that they want, and that the institution for which they are responsible is suffering from his presence. I presume they are at liberty to take advantage of that condition in his tenure?—*A.* They have the power, certainly.

201. You admit they have got the power?—*A.* Yes.

202. Should you think they were wrong in using it?—*A.* What I suggest is that they should be extremely chary in the way in which they exercise it.

203. The interests of the students are a secondary matter, do you think?—*A.* No, I do not.

204. You would not go so far as that?—*A.* No.

205. The Secretary of State has given you a gratuity, has he not?—*A.* Yes.

206. How much?—*A.* 525*l.*

207. *Sir William Bisset.* You have been asked if the President were to hold that the teaching of the present incumbent was not what was wanted, whether you would accept his decision or not; and practically I understand you have answered that question?—*A.* Might I ask you to repeat that, because I do not know that I have answered that question.

208. There is a person named in the agreement—I believe it is the President that is named—if the President were to hold that the teaching was not what was wanted exactly, and that he wanted other qualifications in that teaching, would you accept his decision, or would you not accept it?

209. (*Mr. Leonard.*) You seem to admit that the power is there to remove you, but what you have put forward is, that it is a very unusual step to take?

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—*A.* Yes, and I do not think—at least I am not aware of it—that my qualifications have been called in question either in regard to the work which I have done, or in regard to my ability to meet the alterations which have been made in my subject.

210. *Sir William Preece.* You were first of all appointed Demonstrator in 1892?—*A.* Yes.

211. And for five years you were teaching as Demonstrator in Physics?—*A.* Yes.

212. That was subsequent to your being in Leeds College?—*A.* Yes.

213. What do you consider has been your training to fit you for an Instructor in Electrical Engineering?—*A.* My training has been somewhat varied. To begin with, I went through the ordinary classical and philosophical course at Glasgow, the general education course, and I took the Master of Arts Degree. In addition to that, I went through a course of work in the drawing office, and worked in the fitting and erecting shops of an engineer's workshop.

214. In Glasgow?—*A.* Near Glasgow.

215. What shops were they?—*A.* They were two shops. The name of one of the firms then was David Gray & Co., and the other firm was Messrs. Gibb and Hogg, General Engineers.

216. *Sir Alexander Rendel.* They were not electrical shops?—*A.* No, they were mechanical engineering shops.

217. *Mr. Mansergh.* They did general engineering work?—*A.* Yes.

218. *Sir William Preece.*—I think you made a report, or a memorandum on the subject which I thought was in the Blue Book; I see it is not.—*A.* No, it is not.

219. You did make a report either to Colonel Pennycuick, or to Colonel Ottley?—*A.* Yes, when I was appointed.

220. That has been before us. Do you take telegraphy as a subject of instruction?—*A.* The part of the telegraph course that I take is the instruction in electrical measurements in the physical laboratory.

221. Who does the practical telegraphy?—*A.* Do you mean the signalling?

222. Yes.—*A.* The instructor in practical telegraphy at present is Mr. Edgar.

223. Who is Mr. Duffey?—*A.* Mr. Duffey died a long time ago; Mr. Edgar is his successor.

224. Then Mr. Edgar succeeded Mr. Duffey as technical instructor in telegraphs?—*A.* Yes. I formerly took the signalling instruction myself until a few years ago.

225. I suppose you know there have been very serious objections raised in India to the course through which the telegraphic students have passed before they go out there?—*A.* I know that a report has been made, and I saw the report unofficially. It was not submitted to me officially. I made some notes on it at the time, especially as far as it concerned myself. The reports of the four gentlemen, I forget their names at present, who reported to the India Office as regards myself, and as regards my course, said "the Physical Laboratory course is excellent." That was the only mention they made of my course.

226. That is as regards physics?—*A.* The words "the physical laboratory course is excellent," refer to the instruction in electrical measurements which the telegraph students receive at Cooper's Hill.

227. Now, who does teach practical telegraphy?—*A.* I think he is called the Instructor in Practical Telegraphy.

228. He is not down on this list that I have as one of the complainants. Has he the title of Technical Instructor of Telegraphs?—*A.* Yes. His duties consist now of instructing in signalling, instructing in the use of tools, and in the manipulation of wood, vulcanite, and so forth, in instrument work, and in telegraph construction.

229. Then he knows nothing about Electrical Engineering; for instance, dynamos, motors, and things of that kind; those things you take into your own personal account?—*A.* Yes, those I take.

230. You said, in answer just now to Sir Charles Crosthwaite, that you looked upon your position as being an academical one; but you cannot call your instruction in electrical engineering or telegraphy academic, can you?—*A.* It is academic in a general sense, although not in the sense of being a literary or philosophical or classical appointment. It is academic in the sense that my duties are entirely those of an instructor, and that I am not employed in commercial work. That was the sense in which I meant to use it.

231. Do you mean to say that with the assistance of this Mr. Edgar in the Telegraph Department, you are competent to teach, and in a position to teach, all the advances in electrical engineering that are going on so rapidly?—*A.* Yes. I consider that I am competent to teach the underlying principles of the subject, and able to keep abreast with and to teach as much of the applications of electrical engineering as the men can possibly absorb in the time at their disposal.

232. I presume you will acknowledge that the men who are sent out to India now should know something of the progress of electrical engineering in this country before they go there?—*A.* Certainly.

233. Take, for instance, the rapid steps and advances that are being made in polyphase working; do you keep up to that?—*A.* We cannot keep up to that, for this reason, that although there is a department of electrical engineering, that is to say, although I am a lecturer on electrical engineering, I do not receive the grant of a single penny for the purchase of new machinery or new material, or for the maintenance and repairs of old machinery; so that, of course, it is absolutely impossible for me to deal with these matters practically, simply because I have not money given me to provide the apparatus.

234. Then you are not qualified to give instruction in polyphase working at present?—*A.* Theoretically, yes.; not practically, for want of the apparatus.

235. Do you think if you had the apparatus you might be able to do it?—*A.* Yes.

236. Of course you know the recommendations of Colonel Ottley and the amount of support that we as a Board of Visitors have given to the change that is proposed to be made; what real objection do you personally make to the proposed alteration?—*A.* The first observation that occurs to me in connection with it is, that this proposal to make the electrical engineering course a compulsory one for all students is not new. It was a proposal which was submitted by us to the President in 1895. We drew out a scheme. When I say "we," I mean Professor Minchin, Professor Stocker and myself; and other colleagues were consulted. In 1895, we drew up a scheme dealing with a compulsory course of electrical engineering for the whole College, and this scheme was submitted in the form of a letter written by Professor Minchin to the President of the College.

237. Who was President then; was it Colonel Pennycuick?—*A.* It was Sir Alexander Taylor in 1895. Sir Alexander Taylor did not approve of teaching the whole of the men electrical engineering; it was a waste of time, he said, for men going out to India. In addition to not approving of it, he said that he could not find time for it, and that it would be necessary to diminish the time at present given to surveying in order to be able to fit in the time for the whole of the men taking the electrical course. I presume that for these reasons the scheme was not even submitted to the Secretary of State; at any rate it got no further.

238. I think the fact that this is not new and was proposed in 1895 does not affect the conditions now at all, because there is just as much difference between now and 1895 as there was between 1895 and the time when the College was first established?—*A.* Yes, but at the same time it points out that we were ready then to do it and wished to do it.

239. Nobody said you were not, and I think, as far as we are concerned, we should be rather glad if the improvement had commenced then. You cannot raise any objection to the compulsory teaching of electrical engineering, if you proposed it yourself?—*A.* No, and I have not raised it.

240. Then you raise no objection to the proposal for the alteration of the electrical engineering course?—*A.* Not as regards making it a compulsory subject.

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241. So in regard to the points that have been raised, the only point you raise is the personal one?—*A.* No; there are more points.

242. We should like rather to hear those points?—*A.* The first point is that an analysis of the present scheme for the teaching of electrical engineering will show that every student devotes 100 hours to the subject of electricity and magnetism, theoretical and practical.

243. Is that 100 hours per annum?—*A.* No.

244. *Mr. Mansergh.* Is it extending over the three years' course.—*A.* It is practically all done in the second year; it is not spread over the three years, but is concentrated in the second year. It amounts to 100 hours.

245. *Sir Courtenay Ilbert.* Do you say that every student devotes 100 hours to electricity?—*A.* Yes, every student devotes 100 hours to electricity and magnetism, theoretical and practical.

246. *Sir William Preece.* Is that including in the course the portion of electricity which is taken in physics?—*A.* Yes.

247. As well as that taken in electrical engineering proper?—*A.* Electrical engineering proper is entirely separate, and I am coming to that. It includes merely the instruction in electricity which is comprised under the term "physics" and "physical laboratory." Every student devotes 100 hours to this subject. Then, in addition to that, the third-year men who elect to take it up—they number from six to 12 and comprise the best men of their year, who invariably take up the subject—devote 225 hours additional to it.

248. They are third-year men who do that?—*A.* Yes; therefore those who take up the alternative course devote 325 hours to this subject. Under the proposed scheme the total number of hours devoted to the subject amounts to 230.

249. For everybody?—Yes, for everybody; but it is still possible that that may be reduced, because room is to be found for French and German in the time-table, so that that might even be less. But still, apart from that, the allotment of the 230 hours available is not such as enables the subject to be taught to the best advantage. This would appeal to a teacher at once, or to anyone who is familiar with the nature of the instruction.

250. What is that sheet which you have before you?—*A.* It is the proposed time-table.

251. Of course that has not been adopted; it is only suggested?—*A.* Yes, it is the time-table which has been suggested, and approved by the Board.

252. As printed in the Blue Book?—*A.* Yes. It is the arrangement suggested by the President. You will find that in the first half of the second year the students would have 50 minutes physical laboratory each, and the period devoted to practical physics each week by each man is 50 minutes.

253. I have not gone through any little differences in the figures, but I have put down the times under Physics, Practical Physics, Electrical Laboratory work, and Electrical Engineering work. In regard to Electrical Engineering I make out that seven hours per week are done with these selected men, and that there is no electrical engineering for anybody else; those who take up Telegraphy appear to spend some time in Physics, some time in Practical Physics, and little or no time in Engineering?—*A.* Is that according to the present time-table?

254. That is according to the old one—the one you are working under now.—*A.* The time-table I am referring to is the time-table in the Blue Book, and I find that on Mondays, Tuesdays, Thursdays, and Fridays there is set apart from 2.10 to 3, namely, 50 minutes, for instruction in the Physical Laboratory. You will see at once that those 50 minutes must necessarily be absolutely useless.

255. *Chairman.* I do not think we want all these details. What have you got to say personally why you should not be removed?—*A.* I was trying to give you what you asked me and invited me here to do, namely, my opinion as to the effect of the proposed changes on the teaching of my subject.

256. If we go into all the details of the hours, it will take up a great deal of time?—*A.* May I do it by leaving this memorandum with you? I have simply indicated the points here; I have not gone into details.

257. Yes, you may leave that, provided there is nothing else in it, and that there are no personal attacks in it.—*A.* It is simply what I consider would be the result of adopting this system as regards the efficiency of the teaching. (*The witness handed in a memorandum.*)

258. *Sir William Preece.* We were going on to discuss a thing that does not yet exist?—*A.* It has been submitted and approved, and it is published.

259. *Chairman.* It entirely depends upon Colonel Ottley to extend and alter it to-morrow or any day.

260. *Sir William Preece.* You knew, I gather from an answer that you gave me before, that there were reports from India against the course at Cooper's Hill. Was your attention called to it by Colonel Pennycuick?—*A.* No, I saw a copy in the possession of one of my colleagues.

261. That is Mr. Pitman's report.—*A.* Yes.

262. *Mr. Mansergh.* I understand it was not brought officially before you?—*A.* No.

263. *Sir William Preece.* Did you take any steps to try and remedy the points he brought out? The following is the deliberate official opinion of the head of the Telegraph Department in India in July 1899:— He says: "I would submit—and my opinion is shared by every telegraph officer of "any position to whom I have spoken on the subject—that the present "course is not only capable of great improvement, but that it is inadequate "and in many ways unsuited to the requirements of this Department." Is that what you saw before?—*A.* Yes, I think that is the same report. As regards the references in that report to my own teaching and my own department, they say repeatedly that the course is an excellent one; that is the only reference they make to me. The telegraph course includes mathematics, chemistry, applied mechanics, and a considerable number of other subjects. The general statement is made as regards the whole course; that statement, I maintain, is not made with respect to my part of the course, but on the contrary, what they say about my course is that the course is excellent; and that is stated, not by one of these gentlemen who reported, but by more than one.

264. I cannot find any particular sentence, but that is quite contrary to the report from Mr. Pitman.—*A.* Can I assist you to find it?

265. Have you seen that report (*handing a document to witness*)?—*A.* This, I think, is the identical report.

266. *Chairman.* I have got before me Mr. Pitman's report. He says: "What I wish to emphasize is that the present Physical Laboratory course "is excellent, but not practically useful; whilst, if made to fit in with "Ayrton's book, it would be equally excellent educationally; and have a "practical value in addition." That is quoted from Mr. Simpson by Mr. Pitman. It goes on: "All the physical laboratory work is excellent, but "it would be an improvement if the students were taught regularly the "fault testing of lines by means of an artificial line," and so on. I suppose that is what you mean?—*A.* Yes, and that, of course, has been done; also Professor Ayrton's book has been adopted. I think there are other reports from other individuals comprised in that report.

267. *Sir William Preece.* Yes, there are four others.—*A.* All to the same effect as regards my work—absolutely.

268. *Chairman.* He begins by enclosing copies of correspondence, marginally noted for the information and consideration of the Government of India, and goes on—"These papers relate to the course of training under-"gone by telegraph students at the Royal Indian Engineering College, "Cooper's Hill, and I would submit—and my opinion is shared by every "telegraph officer of any position to whom I have spoken on the subject—"that the present course is not only capable of great improvement, but that "it is inadequate, and in many ways unsuited to the requirements of this "Department." I understand that the question is whether you have seen that report in full?

269. *Sir William Preece.*—Yes, and whether you have taken any steps to remedy the faults which Mr. Pitman brought forward in such strong language?—*A.* I must submit that the strong language does not, and cannot, refer to my department. The reports on my department by the four gentlemen quoted are to the effect that the course is an excellent one. They recommend certain things which might be added to it, and I have taken

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steps to carry out their recommendations. For one thing, Professor Stocker has on their recommendation substituted Professor Ayrton's book as a text book; also that line and earth testing by means of the artificial line forms part of the course. I am always ready, and have always been ready, to take such steps as will improve the department whenever I get any suggestions from people who are able to give them to me, and that I can undertake.

270. *Chairman.* Who is responsible for the teaching of the telegraph students in electricity?—*A.* My senior colleague, Professor Stocker, is, I suppose, nominally responsible.

271. For electricity?—*A.* For the Physical Department and the telegraphic work generally.

272. For the practical electrical technological teaching?—*A.* He is responsible generally, being the senior of the Physics Department.

273. Who teaches the electrical part of it?—*A.* I do—that is, I teach the physical laboratory part of the course.

274. If the electrical telegraph students that we send out are found to be inadequately taught in electricity and defective in practical knowledge, who is to be held responsible for it?—*A.* I must submit that it is not I who must be held responsible for it; I am responsible for my own part of the work.

275. But who is to be held responsible—the electrical lecturer, or who?—*A.* I do not see how you can possibly say that one man is to be held responsible more than another.

276. *Sir William Preece.* It must be either Professor Stocker or Mr. Shields?—*A.* I am responsible for the instruction which they receive in the physical laboratory.

277. Then the only responsibility you assume is the responsibility of grounding these men in physics, as applied to electrical engineering?—*A.* No, in practical physics. My responsibility as far as the telegraph men are concerned is their instruction in practical physics in the physical laboratory.

278. Not in its application to telegraphy?—*A.* In its application to telegraphy, as far as electrical measurement is concerned.

279. *Sir John Wolfe Barry.* We are informed in this paper that we have before us that you are Instructor in Electrical Engineering; is that a mistake?—*A.* I was appointed Lecturer on Electrical Engineering, but for some reason unknown to me, the term "Lecturer" disappeared from one College Calendar, and in the next College Calendar "Instructor" was substituted.

280. Looking down the papers, I see you appear as the Instructor in Electrical Engineering, and nobody else?—*A.* That does not refer to the telegraph students.

281. Who is instructor in electrical engineering—in general, are not you?—*A.* Yes, I am the instructor.

282. I noticed just now that you said "at some time or other." You used the word "We"—"we brought the matter before the President"; was that at a College meeting or what sort of meeting was it at which you brought the matter forward; was it a meeting under the Chairmanship of the President? *A.*—It was submitted to the President in the shape of this letter which is headed "Proposed Improvement in the Course of Instruction in the Royal Indian Engineering College, Cooper's Hill."

283. It was by a letter, then, and not by a discussion at the Board?—*A.* The question was discussed by the professors with whom the subjects were familiar, that is to say, the Professor of Applied Mathematics, the Professor of Physics, myself, and the Professor of Engineering. We discussed the subject and drew up a scheme, which was presented in this letter by Professor Minchin to the President of the College for the information and consideration of the Secretary of State for India.

284. Was there any College Board meeting called to take that matter into consideration—did the President meet the gentlemen who addressed him?—*A.* He saw each of the gentlemen.

285. But not as a Board?—*A.* Not as a Board.

286. Do you attend Board Meetings?—*A.* Yes.

287. How often do you attend Board meetings?—*A.* I attend practically every Board meeting that is summoned.

288. Are they specially summoned?—*A.* Yes.

289. What subjects are discussed at these Board meetings?—*A.* There has been one Board meeting summoned since last July. That was summoned in January. It was described as an "emergent" meeting of the Board, and the subjects discussed were representation of the College at the Glasgow University celebration and the drafting of an address to the King.

290. Those are special subjects and not matters connected with the ordinary teaching of the College?—*A.* Yes, that is so.

291. *Mr. Mansergh.* Prior to that time had there been many College Board meetings?—*A.* Board meetings have been held very irregularly. I could not give you any very accurate idea about how often they have been held because they have been so irregular. The Board Minute Book would show that.

292. And the Board Minute Book would also shew the subjects discussed? *A.* Yes.

293. *Chairman.* Is there not an Agenda Book kept?—*A.* Yes.

294. In which you can put down anything you want brought before the Board?—*A.* That was the use of the Agenda Book.

295. Have you put anything in the Agenda Book lately?—*A.* No.

296. Since when have you not put anything in the Agenda Book?—*A.* A colleague of mine put a notice in the Agenda Book regarding the discontinuance of the wearing of gowns, I think, as a subject to be brought up for discussion at the Board meeting. I was informed that the President saw my colleague and pointed out to him that really he must not put any recommendation in the Agenda Book for discussion unless it had been previously submitted to himself. Since then no one has put a notice of motion in the Agenda Book.

297. I suppose he could have done so if he had first of all spoken to the President?—*A.* The Agenda Book was always absolutely open to us before to put anything down.

298. Have you ascertained whether that was really the case—whether, I mean, your colleague was not mistaken?—*A.* I have got the word of my colleague for it, but beyond that I know nothing.

299. Have you wished to put anything in since or have you put in anything since?—*A.* I have not put in anything since.

300. Have you had any desire to put anything in?—*A.* Yes.

301. And you have been prevented by what your colleague told you?—*A.* I thought the usefulness of the Agenda Book had been entirely annulled.

302. Surely, on an important order like that, you would naturally ask the President whether it was his desire that nothing should be put into the Agenda Book; but you did not apply to Colonel Ottley on the subject, did you?—*A.* No.

303. *Sir Alexander Rendel.* Your position is rather junior at the College, so it would be hardly for you to do it, would it?—*A.* It would not be for me to do it, considering there are many of my seniors with whom the case was familiar.

304. *Sir Courtenay Ilbert.* The teaching of electrical engineering is at present, as I understand, entirely optional at the College, is it not?—*A.* Yes, no one need take it up in the third year.

305. It is an optional subject for the students?—*A.* It is optional in this way—that it is alternative. A man can pass it by, as it were, by taking other subjects in its place.

306. A student can go through Cooper's Hill without learning any electrical engineering; is that the case?—*A.* That is not entirely the case, because everyone puts in 100 hours on the subject of electricity and magnetism, theoretical and practical. Of course, in those 100 hours they get very little instruction in the commercial applications of electricity.

307. What you call electrical engineering, as distinguished from the more general teaching of electricity, is an optional subject, and is taken up by a very small number of students, as I understand?—*A.* It is taken up by quite a small number.

308. About how many?—*A.* From six to 12 of each year.

Mr. T. Shields.

309. *Mr. Mansergh.* And that is in their third year?—*A.* Yes.

310. *Sir Alexander Rendel.* The next take up what?—*A.* Turbine design and architectural design, or turbine design and the chemical laboratory.

311. *Sir Courtenay Ilbert.* Then the proposal is to make the subject compulsory?—*A.* Yes.

312. That, of course, would give it much greater prominence and importance in the curriculum of the College?—*A.* It would.

313. It would be a material change in the curriculum of the College?—*A.* Yes.

314. You will see what I am leading up to; I think I understood what you said about a convention which exists in the case of members of a teaching staff; it is this, is it not, if a member of a teaching staff does well and efficiently the work which he was appointed to do, then whilst things remain the same, his tenure of office is not disturbed. Is not that so?—*A.* Yes.

315. But supposing it is considered, for good reasons or bad, necessary to make a material change in the curriculum of a college or a school, those considerations, although there may be a hardship, do not apply. It may be necessary, or it may be expedient—I am expressing no opinion—to make a change, which would involve the retirement of a member of the staff without any disparagement of the work which he has done up to that time?—*A.* Quite so.

316. That is a possible case?—*A.* Yes.

317. Do you approve in principle of this proposed change, of giving greater prominence and importance to the teaching of electrical engineering?—*A.* Yes, most certainly.

318. May I put it to you in this way rather bluntly—that you think the change ought to be made, and that you ought to be the man to be appointed principal teacher of electrical engineering?—*A.* Yes, precisely.

319. That is your position?—*A.* Yes.

320. *Chairman.* Will you put in any papers that you wish to put on the record?—*A.* Yes. (*The witness handed in a statement of his case, and a comparison of the electrical course with that in another school.*)

The witness withdrew.

Prof. Stocker.

Professor W. N. STOCKER, called and examined.

321. *Sir William Bisset.* You are aged 49, I think?—*A.* My age is 50 now.

322. Were you appointed on the 23rd June 1883?—*A.* Yes.

323. And your previous service had been as Senior Demonstrator of the Clarendon Laboratory, Oxford University?—*A.* Yes; I held that for about nine years.

324. Have you any record of the terms of your appointment? It is stated in the paper that I have in my hand, that the appointment was to be terminable at one term's notice on either side, and that no pension was claimable.—*A.* That is correct.

325. Your present salary is 450*l.* a year?—*A.* Yes.

326. With quarters, valued at 32*l.* per annum?—*A.* That I do not know; I have quarters and coal and gas. I think I was about the last to have that.

327. The subject taught by you is physics and you are Professor of Physics?—*A.* Yes.

328. And your duties include the practical work in the physical laboratory?—*A.* Yes.

329. *Chairman.* How many hours are you engaged in teaching in the week?—*A.* Do you mean just at present?

330. Has there been any alteration?—*A.* There has been an increase, of course, lately.

331. What used it to be?—*A.* There is generally 12 hours laboratory work for the second-year students.

332. *Sir William Preece.* Do you mean per week?—*A.* Yes. Then there are two experimental lectures per week, and also generally part of the telegraph instruction. I should take perhaps three or four hours.

333. *Mr. Mansergh.* What length are the lectures?—*A.* They are one hour lectures.

334. *Chairman.* Is the telegraph instruction given by way of lectures, or in the workshop?—*A.* It consists of laboratory work, electrical testing, &c., with this session, a course of one lecture a week by Mr. Shields. Instruction is given in the workshop by Mr. Edgar, who also gives instruction in signalling and telegraph construction.

335. Your time has been increased now, you say?—*A.* Yes, the number of lectures have been increased.

336. How many hours do you think you are teaching now?—*A.* The chief increase is in the first year's work at present. Now I have three lectures a week instead of one. Of course, that I knew nothing about till the session began. I was not warned of it in any way.

337. It is an increase with the first-year men?—*A.* Yes.

338. *Sir William Preece.* You have no third-year men with you at all, have you?—*A.* Practically this year I have not been doing the third-year work. That has been done by Mr. Shields entirely this year.

339. That is the electrical engineering?—*A.* Yes. It is practically my department, and I am partly responsible for it.

340. *Chairman.* Which are you responsible for?—*A.* It is all under me.

341. All?—*A.* Yes. Electrical engineering comes under physics.

342. Who is responsible for the proper teaching of electricity or the electrical engineering—the practical part of it especially—to the telegraph students?—*A.* What electrical engineering they get would be done by Mr. Shields.

343. Mr. Shields would do it?—*A.* Yes.

344. If there was fault found with the education of the telegraph students would the responsibility for that be Mr. Shields', or yours, or whose?—*A.* This was the condition of my appointment——

345. I am putting the question, and I want to know who is responsible for the proper teaching of the men?—*A.* In the conditions of my appointment I was to supervise,——

346. I am not asking so much about that, I say who is responsible, who does it?—*A.* The electrical testing is done by Mr. Shields almost entireiy; I do it occasionally.

347. Supposing a director of telegraphs in India reports that the men sent out to him are sent out insufficiently taught, who is responsible for that?—*A.* I suppose I should be.

348. You would be?—*A.* Yes.

349. Now with regard to the main alteration that is now proposed to be made in your branch, the main thing is that electrical engineering is to be made compulsory on all the students, is it not?—*A.* Yes.

350. And that, of course, prominence is to be given to it and greater attention paid to it?—*A.* Yes. What the President suggests is, that in the three years each student is to get 189 lectures.

351. Are those to be lectures on electricity?—*A.* 60 of those are on heat, light, and sound, and 129 on electricity. Then they are to be in the laboratory about 102 hours, which makes a total for physics and electricity, or electrical engineering, of 291 hours. At present every student gets 150 hours in the two subjects, and the third year men who take up electrical engineering get 375 hours, which is about 80 hours more than what is proposed. Therefore, in the case of the best men, the suggested change would not be a gain.

352. That is, the men who now take it up would not get any more?—*A.* They would get less.

353. They would get rather less, but the whole body would be obliged to go through the course?—*A.* That is true.

354. Do you think it is a mistake to do that, or do you agree with the principle of the proposal?—*A.* I agree with the principle of the proposal making it obligatory upon everyone, but I doubt if the time is sufficient.

355. There would require to be more time than is now given to it?—*A.* Than is proposed to be given to it.

356. I do not think we want to go into that, the main thing is that you agree that it should be made compulsory?—*A.* Yes, in fact we proposed that ourselves in 1895. I do not know whether that has been mentioned to you.

Prof. Stocker.

357. That being so, if it was found that we required a man with different qualifications to take the electrical teaching, what reason have you to urge against your retirement, supposing it was to be found necessary; what reason on personal grounds would you allege?—*A.* I think the chief reason on personal grounds is, that it would be a slur on my professional reputation.

358. I do not see that. Supposing a man's professional reputation is as a physician, you do not say it is a slur upon him to say that he is not fit to teach electrical engineering?—*A.* Of course, I am not an electrical engineer, I may as well say that straight.

359. Supposing that the Board of Visitors felt compelled to advise the Secretary of State that we must have a man with considerable practical knowledge, and up-to-date knowledge, of electric technology, and that we do not think Mr. Stocker is the man, or Mr. Shields is the man, then, in that case, and supposing those conditions, what have you to urge as a reason against the change?—*A.* Of course, that is a matter of opinion. I should be of opinion that the present staff could carry on.

360. That is a question of opinion?—*A.* Yes.

361. Supposing the Governing Body are of the opposite opinion, and think that they are not doing their duty by retaining the present staff, do you consider that in that case the Governing Body should not act upon their opinion?—*A.* I suppose they ought to act upon their opinion if that is their opinion.

362. Now about the College Board. There is a College Board which is called together by the President when matters are to be discussed, is there not?—*A.* Yes.

363. What is the procedure with regard to that, supposing you want to bring a question before the President?—*A.* We used to enter it in an Agenda Book or a suggestion book.

364. You used to do that?—*A.* Yes.

365. But now?—*A.* There has not been a Board meeting lately, not called on our side.

366. Has anybody called one. Has anyone put anything in the Agenda Book?—*A.* I understand that someone did put something in and it was ruled out.

367. Have you wished to put anything in since?—*A.* Personally I have not.

368. Then really there is no reason to suppose that he has ruled it out?—*A.* I only go by what I was told.

Chairman.—The question raised was whether the staff should or should not continue to wear gowns. Here is the minute upon it:—"This is a "matter which the President considers may well be left to the individual "wishes of members of the staff. Those who prefer to wear their gowns "will be all at perfect liberty to do so, and those who prefer not to wear "gowns will not do so."

369. *Sir William Preece.* I want to ask you about this teaching of physics to the third-year students. You only teach physics now to the first-year and the second-year students, and you teach nothing whatever to the third-year students; is that on your recommendation, or has it been the practice in the College?—*A.* It has been the practice from the beginning, except in the case of a certain number of students. There are always some third-year men who take it.

370. And they take it optionally?—*A.* Yes, and they are the best men of the lot. It is called electrical engineering now.

371. That is what I want you to come to; it is called electrical engineering, and you regard the teaching of physics as an essential branch of electrical engineering?—*A.* It is the foundation of it.

372. Electricity and magnetism is the foundation of electrical engineering?—*A.* Yes.

373. And that is a branch of Physics?—*A.* Yes.

374. Again, would you regard tests in a laboratory and experimental work part and parcel of the education of an electrical engineer?—*A.* Certainly.

375. If that be so, what is there in this proposition here which can be said in any way to impair the instruction in science in Cooper's Hill College?—*A.* I do not know that you can say that. *Prof. Stocker.*

376. The whole gravamen of the accusations brought against us by the Royal Society and the people who signed the memorial are to the effect that we are ignoring science and blotting science out from the curriculum of Cooper's Hill?—*A.* I think that was chiefly because it rather looks like that, if all the staff in the physical laboratory is dismissed.

377. It looks like it, if you take it from the point of view of the staff themselves; but if you acknowledge that we propose to improve the study of physics and the teaching of physics, it means that we have to bring in other men—whether they are better men we do not say. It does not imply that we are going in any shape or form to attack science or to impair science, or to diminish the amount of scientific instruction given in Cooper's Hill College.—*A.* Yes, but you cannot imagine that one man can do efficiently the work which has been done by two.

378. There is nothing to justify the assumption that it is only for one man to do it.—*A.* That is the way I have read it.

379. That is the way it is read, and that is the way in which it has been expressed, and that is the way in which it has been published; but I want you to acknowledge that it is not the truth.—*A.* I do not know that I am prepared to say that.

380. The whole foundation of the profession of an engineer is based on physics, and physics must be taught, and it is proposed to be taught; it is taught now to first and second year students, but it is not taught to third-year students, and I do not know why.—*A.* Really, I gathered from the Blue Book that one man was supposed under the new arrangement to teach Electrical Engineering, Physics, and Chemistry. That is how I read it.

381. You read it in Colonel Ottley's report, but you will find that that does not exactly tally with the recommendations of the Board. On page 42 you will see: "The advance of this branch of science is very rapid, and in order "that the students may keep abreast of it, it is advisable to supplement the "teaching of the permanent instructor by calling in the best lecturers "obtainable from London or elsewhere." That is as regards the question of science being taught. Now, I want to put this to you; do you regard Cooper's Hill as a mere academical college, as a scientific college? Is it not rather essentially an engineering college, using the term "engineering" as meaning "applied science"?—*A.* I think it is the latter, but it may be added that we have to teach also the science which is to be applied.

382. And the sole object of this College is to turn out practical engineers, and to send them trained out to India?—*A.* Yes, and to send them trained out to India and elsewhere.

383. Also that they are, to a certain extent, to undergo that training which, as a matter of course in this country, they receive in the offices of consulting engineers and engineers?—*A.* Yes.

384. On that question, is there a single point in this report, and in the action which the Board of Visitors recommend and propose to take, which can be said to deteriorate the position of science, which can in any shape be said to impair the education of the practical engineer, and which can be said, as it has been said in public, that it is making the engineer and men of that class on a par with plumbers and glaziers?—*A.* No, I think not.

385. We gathered first from Mr. Shields that you are responsible for all that goes on in your department; that you are responsible for the teaching of Physics, for the Electrical Engineering, and for that of Telegraphy; personally you take complete control of the teaching of Physics both in the lectures and in the laboratory; but you have a deputy in the shape of Mr. Shields to take up the subject of Electrical Engineering, and you have another kind of deputy to take up the subject of Telegraphy?—*A.* Yes.

386. Take electrical engineering, which is growing at such a rapid pace; can you honestly say to this Board that you think Mr. Shields is perfectly competent to undertake the teaching of electrical engineering to the students at Cooper's Hill?—*A.* I should have no hesitation in saying that he was competent.

Prof. Stocker.

387. Will you say the same of Mr. Edgar, who takes charge of telegraphy?—*A.* Yes, I think he does his work very satisfactorily, and takes a great deal of trouble about it.

388. Then how do you account for the fact that we have received, and are still receiving nearly every day, reports from India and complaints from India of the wretched instruction received by the telegraph students who go out there?—*A.* I do not think it is the instruction, I think it is the men we have had.

389. You are not responsible for selecting the men?—*A.* No. They go so low down in the list for them. This year I think there will be an improvement, as they have got very good men. The Telegraph Service has not attracted the best men.

390. You are quite right there. There have been some very great duffers sent out, and on the other hand, there have been some very good men sent out.—*A.* Yes.

391. Perhaps the best men in India are from Cooper's Hill, and they have done remarkably well; but latterly you have been rather deficient in the quality of the men?—*A.* Yes, that is quite true.

392. Still, if the proposed alterations tend to secure better men, and if the proposed suggestions approved of by the Board of Visitors improve the instruction also, then we shall be able to meet all the complaints from India?—*A.* Yes.

393. *Sir John Wolfe Barry.*—I think you said that you considered that, assuming electrical engineering was to take a very much more important part in the curriculum of Cooper's Hill than it has done up to this time, the present staff could "carry on"—I think those were your words?—*A.* I will agree to that, but I do not know whether I used those words.

394. I took them down at the time. I think you said you yourself did not pose as an electrical engineer?—*A.* Not as to the practical part of it.

395. Then how would the present staff carry on?—*A.* It would increase the number of physics and electricity lectures required, that is the more theoretical part.

396. Who would be the leading man in electrical engineering if the present staff were carried on?—*A.* I do not know. As long as I am there, I must be the leading man, because I have got the command of all the apparatus.

397. But you have told us that you do not pose as an electrical engineer—you are more a man for the abstract science of physics?—*A.* Yes.

398. Then who would be the person?—*A.* Of course Mr. Shields would.

399. Then he would be the man who would have to be brought to the front, according to your idea, as the representative and chief man on electrical engineering?—*A.* Yes.

400. Do you think he is thoroughly qualified for that?—*A.* Yes.

401. By his experience and general knowledge of the subject?—*A.* Yes.

402. You said nothing has been put in the Agenda Book "by our side;" what do you mean by "our side"?—*A.* I do not think I said that.

403. Yes, you said nothing has been put down in the Agenda book "by our side"?—*A.* I meant on the side of the staff.

404. On the side of the staff in general?—*A.* Yes, because the President may put down the agenda.

405. You meant then the members of the professorial staff?—*A.* Yes.

406. *Sir Courtenay Ilbert.*—I very much sympathise with what you say about the slur. Supposing it were made perfectly clear that, so far as you were concerned, the proposed changes have nothing whatever to do with your being incompetent to do the work which you were appointed to do, or having done that work inefficiently, but were made solely on the ground that the article you supply is not precisely the article which is wanted—I am just putting it in that way—or that the existing distribution of the work is inconvenient and wasteful; supposing that were made perfectly clear, would that satisfy you as far as you are personally concerned?—*A.* I think it would.

407. *Chairman.*—You are not entitled to a pension, are you, by the terms of your service?—*A.* No; I was the first who was not.

408. The Secretary of State has given you a pension, has he not?—*A.* Yes, that is so.

409 Do you not think that giving a pension to a man who is not entitled to claim it at all, is quite enough to show that the Secretary of State did not intend to convey any slur upon his character or abilities to do the work for which he was engaged ?—*A.* It would tend that way, no doubt.

410. It would, when he goes out of his way to give a pension ?—*A.* No doubt it does.

411. I want to emphasize that the pension was given although we were not obliged to give it ?—*A.* Yes, that is so.

412. *Sir Alexander Rendel.*—Do you attribute the failure to turn out well instructed men in telegraphy rather to the men who came to be taught than to the teaching ?—*A.* Yes, I do.

413. You have been getting inferior stuff to deal with at Cooper's Hill ?—*A.* Yes.

414. Cooper's Hill does not attract good men ?—*A.* No; the conditions of the telegraph service do not attract our best men. You see they are selected at the end of the first year.

415. Putting aside the best men, the rest are inferior in ability or in some other quality necessary to make a useful man ?—*A.* Yes, they are, towards the end of the list.

416. Cooper's Hill has not attracted of late a large number of good men ?—*A.* There is a tail.

417. And the tail has been a very long one ?—*A.* Yes.

418. Why is that ?—*A.* I can hardly say.

419. Is it the costliness of the College ?—*A.* That may have something to do with it.

420. What does it cost a man to get through Cooper's Hill ?—*A.* The necessary fees are something like 183*l.*

421. *Mr. Mansergh.*—Is that for the three years ?—*A.* No, for a year.

422. *Sir Alexander Rendel.*—How much over and above that 183*l.* does a man spend per annum in order to pay all his expenses ?—*A.* I think he would want another 100*l.*

423. Then a man does not get through Cooper's Hill much under 300*l.* a a year ?—*A.* No.

424. And telegraphy is not good enough to attract the class of men who can afford to spend 300*l.* a year on their education ?—*A.* That is so.

425. *Sir William Preece.*—Is that what you mean ? The impression that you left on me was that the good men mentally who are up in the front, select the engineering appointments, and that the telegraph appointments in India are not attractive enough for them, so that it is only those who know that they will fail in the examination who take the telegraph appointment ?—*A.* That is so.

426. *Sir Alexander Rendel.*—The appointments at Cooper's Hill are not good enough to attract men who can afford to pay 300*l.* a year for their education in a sufficient number to fill all the appointments given at Cooper's Hill ?—*A.* That is so.

427. *Chairman.*—That is to say to fill them satisfactorily ?—*A.* Yes.

428. *Mr. Mansergh.*—It is not the telegraph work alone; it is the whole of the appointments that are open at Cooper's Hill ?—*A.* Yes.

429. *Sir Alexander Rendel.*—There are a certain number of appointments open to engineers ?—*A.* Yes.

430. Those are first class appointments ?—*A.* Yes.

431. Then there come the forestry appointments, which may be called second-class appointments ?—*A.* The forestry appointments stand on a separate footing. There is a separate entrance examination for them held by the Civil Service Commissioners.

432. Then there come the telegraphy appointments, which may be called third-class appointments ?—*A.* Yes.

433. There are not enough good men going to Cooper's Hill to fill up the three classes of appointments ?—*A.* That is so.

434. So only the refuse, as it were, take telegraphs ?—*A.* Yes.

435. *Sir William Preece.*—Even bad as things have been in the past they are better this year, and will be better in the future if we make the entrance examination stiffer ?—*A.* No doubt. I think there is a suggestion to make a three-year course for the telegraph men and to increase their salary on going out.

Prof. Stocker.

436. *Sir Alexander Rendel.*—Your entrance examination has not yet been stiffened, has it?—*A.* That is a thing I know nothing about, as I have nothing to do with it.

437. *Sir William Bisset.*—You have no preliminary examination in physics, have you?—*A.* No.

438. *Chairman.*—Do you wish to put in any statement?—*A.* I have prepared a statement simply to show that in the past the staff have tried to increase the efficiency of the teaching and to keep it up to date, and that they have not shirked any additional work. (*A written statement was handed in subsequently through Professor Hearson.*)

439. *Sir William Preece.*—I think we are fully aware of that, and I do not think there has been a whisper to the contrary. We have had several reports, especially of Mr. Pitman when he was the Director-General of Telegraphs in India, to the effect that the course of training was very deficient and practically useless in telegraphy, and you knew of that, did you not?—*A.* Yes I did know of that. You can do so little in one year.

The witness withdrew.

Prof. McLeod.

Mr. HERBERT MCLEOD called and examined.

440. *Chairman.*—Are you 60 years of age?—*A.* I was 60 on the 19th of February.

441. And you were appointed Professor of Physical Science in Cooper's Hill on the 1st of May 1871?—*A.* Yes.

442. Before that what employment had you?—*A.* I was assistant chemist at the School of Mines in Oxford Street.

443. Is that the same as the Geological Museum?—*A.* The Geological Museum is part of it, and the Royal College of Science at South Kensington is the same institution.

444. When you were appointed Professor of Physical Science, what were the terms of your appointment as to termination, pension, and so on?—*A.* The appointment was for as long as I did my duty to the satisfaction of the President, and there was a proviso, of course, which is common, I believe, about a term's notice on either side without reason assigned. I was allowed a house, an allowance for coals and gas, and 600*l.* a year.

445. *Chairman.*—Then if your appointment were abolished, or if it were desired on economical grounds to reduce it, you would be entitled under the Superannuation Act to terms?—*A.* Yes, I suppose so.

446. Have you been offered those terms?—*A.* I have not been offered any terms at all. The pension is exactly the pension, or rather less than I would have had if I had retired voluntarily at the end of this session. So I calculate, but I may be wrong. There is no compensation.

447. *Chairman.*—We have gone strictly according to the Treasury practice. You have got a gratuity of 185*l.*?—*A.* Yes.

448. We know that you are a very distinguished chemist, will you tell us what your scientific qualifications are, your degrees and so on?—*A.* I have not any university degree. I never went to a university. I began my work at the College of Chemistry at the age of 16, and I have been at work at the subject ever since. I am a Fellow of the Royal Society, a Fellow of the Chemical Society, and of the Institute of Chemistry. I think those are all the qualifications that are of interest.

449. How many hours a week do you teach at the College?—*A.* In the first two terms of the session there are two lectures on chemistry and in the third term one, making 50 in the year. That was the number of lectures decided on by the Board of Visitors in 1883. Then the laboratory work has been rather varied.

450. Are those lectures in the year all the lectures?—*A.* Those are all the lectures that are given in inorganic chemistry.

451. Which is your subject?—*A.* That is my subject.

452. Besides that, you take them in the laboratory?—*A.* Besides that we have the laboratory work. There are at present three attendances of 3 hours each compulsory and an additional 4 hours, or rather 2 hours on two days, optional.

453. Taking it altogether, how many hours a week are you engaged in teaching?—*A.* Actually in the laboratory I would be about 13, and then there would be the two lectures. But I must say that the preparation of the

lectures is not at all included, and all the work in regard to the experimental lectures is in a very large proportion outside the lecture room altogether. *Prof. McLeod.*

454. You mean in preparing for the lectures?—*A.* Yes.

455. Are the lectures which you give in class oral, or have you a written series of lectures?—*A.* I do not read my lectures. I have notes for those lectures. The work in the laboratory is for qualitative analysis. The men have really 90 hours in the year, which is a very small amount indeed. Putting it into days, it comes to about 15 days' work, and in that 15 days' work we manage to teach the men to do a qualitative analysis of a simple substance, which I think is fairly good work for the time.

456. These men are being educated as engineers; that is to be their profession?—*A.* Yes, and foresters of course; they all come to the lectures.

457. Do you think it is necessary for an engineer to be highly instructed in chemistry?—*A.* That is more for the engineer to say than for me. Of course I cannot say that. I introduce into my course anything which my engineer colleagues desire.

458. Is it possible to take them to a high degree in chemistry in the time that they have?—*A.* No, not to a high degree; but I think they get a very good general knowledge of chemistry, which they can apply afterwards as they require it.

459. You cannot take them on to a very advanced stage?—*A.* No. I should add that in the second and third years there is an optional attendance. In the second year the students may work in the laboratory, and in the third year hitherto we have had a course of chemistry alternative with physics and architectural design; and we have had numbers varying from one up to six or seven (there happened to be none this year), and they do quantitative work. Sir Alexander Rendel will know the kind of work which they have done in the laboratory.

460. For the Forestry Department, I take it that organic chemistry is necessary?—*A.* Yes, and that is taught them by my demonstrator.

461. Why do you not teach that?—*A.* It is a subject which I have forgotten. After having worked for about 20 or 30 years on inorganic chemistry only, my organic chemistry naturally has got rather rusty, so when Professor Church retired I suggested that Dr. Matthews should take the work, because he has worked principally on organic chemistry.

462. I suppose otherwise there is not more than one man could do?—*A.* I should hardly like to say that. If the course is very much diminished one might do it, but I do not think one man could do it alone now. You see there are the lectures and the preparation for the lectures. Of course there is a lecture assistant to do mechanical work, but the lecturer himself has to see to the arrangement, and there is a certain amount of preparation for the laboratory and the maintenance and supervision of the whole thing.

463. Do you think Dr. Matthews is a capable man?—*A.* Yes, certainly. I have not heard him lecture actually, but I have heard him give demonstrations to the students, which I think he does very well. I have no doubt whatever that his lectures on organic chemistry are just as satisfactory.

464. Do you think you would be aggrieved if the Secretary of State thought it necessary to make a change?—*A.* After having worked for 30 years without any complaints whatever from anybody, it is rather a surprise to be told that you must go in three months. I must tell you honestly that when I first opened the paper I thought it was a matter of age, as at that time I thought the retirement was at 60 years, and not at 65 years.

465. *Sir William Preece.*—60 is the age in the Civil Service?—*A.* Yes, but for all professors it is 65. When I turned over the page and found the names of six others of my colleagues I was very much astonished, naturally.

466. *Chairman.*—Do you not think it is rather a waste of money, considering the amount of chemistry that we can teach, and that there is time to teach, because remember the essential thing is to make engineers of those men?—*A.* I should like to make one remark. I joined the College when it was first opened, with Colonel Chesney, and he attended many courses of my lectures without ever making the slightest remark of disapprobation as to the subject. He was an educationalist, and he, I suppose, knew what an engineer required. I continued on those lines entirely, adding, of course, as knowledge increased, and omitting things which were not necessary.

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467. Considering that we cannot make good chemists of them in the time, and that if we could it is not necessary for the work that we want them to do to know more than the elementary part of chemistry, do you think that it is reasonable to spend so much money upon it as is entailed by keeping a man of your scientific abilities and eminence at a high salary, when we could get it done by a less eminent man?—*A.* That is not quite for me to judge about. I must say that I do not think it would be at all possible to do what Colonel Ottley desires, namely, to obtain such a teaching of the students as will give them just sufficient knowledge of chemistry to enable them to interpret the results given by professional chemists. I think it is absolutely impossible to frame a syllabus which will cover that and not go beyond. You must teach them a great deal more of chemistry. You must teach them the principles, and then, when they have these once grasped, they can understand it. I do not think it is at all possible to lower the teaching down to a standard which is practically no standard at all. That is my own feeling, and I think it would be the feeling of any other scientific man.

468. *Sir William Bisset.*—You have just said that it will be impossible to give them what you would call a moderate knowledge of chemistry without training them to a higher point; that is to say, they will not be competent to understand anything without understanding a great many things more; in other words, you think the course proposed would be an insufficient one to be of any use, and really had better be abolished?—*A.* Of course I hardly like to say anything about abolition.

469. Practically, I understand you to mean that if it was necessary to curtail it, it would be better to abolish the chemistry course?—It is rather hard to say that. I do not wish to commit myself so far as that. According to this timetable, which Colonel Ottley has proposed, instead of there being 50 lectures there will be only 30. Then there will be in the first half of the first year two hours a week in the laboratory, and in the second half of the second year—with an interval of 12 months, for what reason I do not understand—there will be three hours a week. There may be a reason for that which Colonel Ottley has had, but, as you all know, none of us saw this timetable until the Blue Book was printed, and it has come to us quite by surprise. No one, I think, of ourselves, and probably no one who has been accustomed to educational work, could have compiled a timetable like this without seeing that it was very inadequate. The men begin chemistry in the first half of their first year, and then they leave it for a whole 12 months and continue in the second half of the second year. Naturally they must have forgotten a good deal then. There may be a reason for it, but that I must say I cannot explain.

470. *Sir Alexander Rendel.*—Do you think it is possible to get in the whole of this engineering course at Cooper's Hill in $2\frac{1}{4}$ years?—*A.* The feeling has been, you know, that we ought to have a four years' course at Cooper's Hill.

471. It is four years' work crushed into two years and three months?—*A.* What do you mean by the three months exactly?

472. If you take the holidays into account and the fact that a man enters in October and leaves three years later in July, you will find that it comes to about two years and three months; or, if you like to take in the vacations, two years and nine months. The whole course is crammed into those two years and nine months, and you are beginning with men of not by any means the highest standard of initial knowledge?—*A.* Yes.

473. Is it possible to teach them decently all that is taught in that time?—*A.* I believe that in America and on the Continent they are making the courses for these technical colleges to extend over four years. But I am not an engineer, as I say. I only know what I hear from my colleagues and other people, and the course at Cooper's Hill has always been considered short.

474. You cannot possibly teach them the minimum of chemistry in less time than they now get?—*A.* I should think not.

475. *Sir William Preece.*—I think when you were originally appointed you were appointed as Professor of Physics?—*A.* Experimental science.

476. Was it not physical science?—*A.* I forget the exact words, whether it was experimental or physical science.

477. And you held that position for 12 years?—*A.* Yes.

478. So that during those 12 years you were the only teacher of physics and chemistry?—*A.* Yes.

479. That extended to 1883, did it not?—*A.* Yes.

480. And since then four men are employed in doing what you did alone?—*A.* No, excuse me; it is very different indeed from what it was. When I was first appointed I lectured on chemistry one year and physics the next, alternately, the first and second year's men always attending together. There was no physical laboratory. The attendance at the chemical laboratory was optional, and the laboratory was large enough for only 12 men. When in 1883 the Board of Visitors, I believe principally on the advice of Sir William Siemens, insisted upon science being taught more thoroughly, they ordered that every student should pass through the chemical laboratory and that every student should pass through the physical laboratory. The physical laboratory had to be built, and then there were two laboratories to be managed, and it was necessary therefore to have a Professor of Physics and a Professor of Chemistry and a Demonstrator in Physics and a Demonstrator in Chemistry. That is how it was.

481. That means that the teaching of science in Cooper's Hill has been very much increased?—*A.* It has been increased, certainly.

482. And on the work, and at the suggestion of the Board of Visitors?—*A.* Yes.

483. Do you imply that this new change, proposed by Colonel Ottley and supported by this Board of Visitors, does in any way impair the scientific teaching at Cooper's Hill?—*A.* With regard to the physics, I cannot say that I have been into the matter, but I do think that chemistry will suffer by the diminution in the hours.

484. I have taken the trouble to find out the number of hours that are devoted to chemistry teaching in every other technical institute, for, mark you, after all, Cooper's Hill is not a scientific college, but it is a technical institute, an engineering establishment for the preparation of practical engineers.—*A.* Yes, it is.

485. You have at least three times as many hours devoted to chemistry at Cooper's Hill as is devoted to that subject anywhere else.—*A.* I was not aware of it.

486. That is the fact. I am going to have this document typed, as I think it is worth having, and you shall have a copy of it. We have had complaints from India; and we have had an official report from Mr. Pitman, who was Director-General of Telegraphs in India, recommending the abolition entirely of chemistry; so that in diminishing the number of hours Colonel Ottley has not done it out of mere whim, but he has done it from sheer conviction, supported by us, who include among our number practical engineers who know as much about the requirements of an engineer as most men. We concur with the proposal that the number of hours devoted to chemistry should be reduced. The hours can only be reduced by adding something scientific. If we take away an hour of chemistry we propose to replace it by an hour of physics. Therefore we do not impair the scientific branch of the matter at all. On the other hand, we propose to throw the teaching of organic and inorganic chemistry into the hands of Dr. Matthews, who is a competent man?—*A.* Yes, he is.

487. You will not for one moment say anything to the contrary?—*A.* I will not say one word against him.

488. On the other hand, you have acknowledged yourself—and I do not want to get you to acknowledge it again—that you have forgotten organic chemistry and that you are not prepared to teach it?—*A.* Certainly.*

489. So far as regards chemistry, you have not much to say against us?—*A.* No, I am not at all saying anything against any person. I am merely saying that this has been done without any consultation with us, and that it has come upon us by surprise.

* I should like to be allowed to qualify this answer, and also the previous one on the same subject on p. 25. Organic chemistry has made such enormous progress in recent years, and, as my work at Cooper's Hill has been entirely on inorganic chemistry, I have not kept pace with the organic branch of the science, so as to feel myself competent to undertake teaching of it. Whilst Professor Church was lecturing to the Forest students, Dr. Matthews acted as his assistant, and was quite familiar with the course of lectures, so, when Professor Church retired, I suggested that Dr. Matthews should succeed him, especially as his doing so would make some addition to his income.

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490. We quite know that.—*A.* If we had been consulted we might have been able to meet any requirements that the President thought necessary.

491. That is not the subject we are enquiring into with you; we may have to say something to somebody else on that point. You admit that we do not propose to impair the scientific training in Cooper's Hill?—*A.* By "scientific," do you mean chemistry and physics?

492. Yes. You admit that during the past 20 or 30 years there have been great advances made in scientific teaching in Cooper's Hill?—*A.* Yes.

493. On the the initiative of the Board of Visitors?—*A.* Yes.

494. Do you think, from your experience of Cooper's Hill, that there would be an advantage in increasing the term to four years?—*A.* That I really could not say, because it includes so much other work. I am speaking more on my recollection of what happened three or four years ago in Professor Reilly's time. It was said that more time was advisable, and if we got four years we should do very much better. I believe I am right in saying that in some other colleges abroad they are extending it to four years.

495. It has been mooted with respect to Birmingham, and reports have been obtained from the United States, greatly in favour of four years, but that is not before us now. Was this report of Mr. Pitman's referring to the telegraph work brought before you?—*A.* It has never been before the College Board certainly, and it has never been published to the whole of the members of the College Board. It was put into the hands of Professor Stocker, and he showed it to the Demonstrator, Mr. Shields, and Mr. Shields has told me about it. That is all I know of it.

496. Was that the fault of Colonel Pennycuick?—*A.* Do not blame Colonel Pennycuick for that. I should like very much to say that in looking through a book yesterday, which is a book of notices and memoranda to the staff, all through Colonel Chesney's time, I continually came on a record of this kind. "Report from India placed in the professors' box for information," over and over again I came across that. That has very much got out of use, and it does not now happen at all. We hear nothing of these reports about the College work amongst the whole of us; they may go to one or two, but not to all.

497. *Sir Alexander Rendel.*—I daresay you remember the old School of Mines?—*A.* Yes.

498. The whole of the first year was given to chemistry?—*A.* Yes, it was.

499. Of the three years, one-third was given entirely to chemistry?—*A.* Yes.

500. And the men used to work very hard at it all day long?—*A.* Yes. They had a lecture on chemistry in the morning in Oxford Street, then there was laboratory work beginning at 11 o'clock and going on for the rest of the day. Some of the matriculated students came down to another lecture during the afternoon at Jermyn Street—one of the physical lectures, I think it was; so they did not get the whole day, but they got a large portion of it. The actual work in the laboratory extended during the whole of the nine months.

501. *Mr. Mansergh.*—If the time devoted to chemistry is cut down as intended, do you think it is worth keeping up chemistry at all?—*A,* That is really much more for the engineers to say whether they think they will get sufficient chemistry from the men in the time. That is for them.

502. If it is cut down to a third of the time, would that be of any use at all, do you think, for an engineer?—*A.* I should not like to answer that question off hand. It would be necessary to see what has been done at the other colleges, where the amount is the same. I should not like to answer it on my own responsibility. What I have always done is to go through the course of theoretical chemistry, going through the principles as exactly and carefully as I could and allowing the students to apply them to engineering as they like.

503. *Sir William Preece.*—But stil lchemistry must be added to the Forestry Department?—*A.* Yes, and a good deal of it, and they must have the inorganic chemistry as well.

504. And it is essential for electrical engineering too?—*A.* Yes.

505. *Mr. Mansergh.*—Is there enough of it, that is all I say, if it is cut down to be useful to the engineer?—*A.* Fifty lectures and 15 days' work is all that the men get.

506. *Sir William Preece.*—But it means examination, and it means marks and it means private study, and it also encourages great interest in one of the most interesting experimental branches of science?—*A.* That of course is what it is done for. *Prof. McLeod.*

507. *Sir John Wolfe Barry.*—Are you acquainted with what is done in the case of the mechanical science schools at Cambridge?—*A.* No, but I have heard that the amount of chemistry which Professor Ewing requires is very small.

508. *Sir Courtenay Ilbert.*—Do you think it would be practicable to reduce the proportionate time given to chemistry in the Cooper's Hill course; I was not quite sure what you said on the subject?—*A.* I think not, myself. I say the quantity is very small, 50 hours at lectures, and, if you put it all together, 15 days' work in the laboratory.

509. Then you do not think it would be practicable to reduce the amount of work done in the chemistry to such an extent that it could all be taught by one man—because that is the point to bring out. Of course that was the gist of the proposal, that the amount of time given to teaching in chemistry should be so reduced that it should all be capable of being taught by one man?—*A.* I should think it would be difficult myself. Take as the one man, Dr. Matthews, who has at present the organic chemistry for the foresters and chemistry of soils. It is, of course, perfectly true that it appears to be a small number of hours, but that is not the whole of the work entailed on a chemist who is lecturing on experimental work. He has to prepare his apparatus, and he has to revise his lectures continually. It is a matter of continually reading up, and reading periodicals. Hardly a week passes that I do not put a memorandum into my notes of something which must be added. All that has to go into the time, I believe. It is not the time the man is actually in contact with his students; there is a great deal more than that which he has to do. I should, perhaps, leave with you the notes that I have prepared. There is one matter I have not mentioned at all, and that is our meteorological observatory, which I have had going since 1872, and which, of course, takes up a large amount of time (*handing in statement*).

510. *Chairman.*—Would you like this put on the record?—*A.* I think so. I do not think I have said anything there which should not be included.

511. There is nothing personal in that?—*A.* Nothing whatever.

The witness withdrew.

Mr. Thomas Alfred Hearson called and examined. *Prof. Hearson.*

512. *Chairman.*—I believe you are a member of the Institute of Civil Engineers?—*A.* Yes.

513. Have you any other degrees?—*A.* I am a member of the Institution of Naval Architects, and I have other qualifications which are not well known; for instance, I am a Fellow of the Royal School of Naval Architecture and Marine Engineering, with a diploma of "First Class" and a Whitworth scholar. Also, I have been for many years Principal Examiner in Machine Construction to the Board of Education, and for the last two years Examiner in the Mechanical Sciences Tripos for the University of Cambridge.

514. Your age is 52?—*A.* Yes.

515. You were appointed in September 1884?—*A.* Yes.

516. Prior to your appointment at Cooper's Hill, where had you been?—*A.* I was assistant to Professor Cotterill at the Royal Naval College, Greenwich.

517. Were you there for many years?—*A.* Ten years.

518. I believe you have been continuously at Cooper's Hill since 1884?—*A.* Yes, that is so.

519. What was the designation of your appointment at Cooper's Hill?—*A.* Professor of Hydraulic Engineering and Mechanism, sometimes worded Professor of Hydraulic and Mechanical Engineering.

520. What were the terms of your appointment as to tenure?—*A.* I have with me the leaflet on which the appointment was advertised, it says "The "appointment will be tenable so long as the duties are performed to the "satisfaction of the President, with the proviso that the engagement may

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" be terminated on either side without reason assigned on notice being given " one term in advance."

521. What is your salary ?—*A.* 600*l.*

522. With a house ?—*A.* It was advertised as with bachelor quarters, but as I was married Sir Alexander Taylor promised to me the reversion of the next house when it fell vacant.

523. What has been the principal subject of your teaching ?—*A.* Hydraulics, machines, thermo-dynamics, sanitary engineering and descriptive engineering relating to machines, boilers, and engines.

524. How long in the week do you give to teaching ?—*A.* In actual lectures I think it works out to about 10 hours per week.

525. What other work is there ?—*A.* Laboratory work.

526. *Sir Courtenay Ilbert.*—With the students ?—*A.* Yes. Then there is the work of looking after the students during seven weeks in the session when they are making their mechanical design, which involves attendance on the students in their rooms, which on some days will amount to three or four hours a day.

527. *Chairman.*—What do you mean by looking after them while they are making these designs ?—*A.* Helping them when they get into a difficulty. They send sometimes a note to me " will I come and see them," and when I do not get that note I go round to their rooms and pay casual visits to see how they are progressing.

528. What is that mechanical design ?—*A.* It is a turbine design. The purpose of the work is to teach them the design of some machine, and inasmuch as hydraulics as well as machinery is a part of my subject, I have been able to bring both branches of my teaching into the question. Another advantage belonging to it is that, inasmuch as we have to make it competitive work, one must give them a definite and separate problem, so that one man may not do the design and another man copy it. In regard to the turbine, by varying the quantity of water, the fall and the power, one can give an infinite number of problems of about the same difficulty and require each man to work out his own figures. It is an extremely successful piece of work in that respect, and it may be worked out by theory, there being very little rule of thumb involved.

529. Then you take the hydraulics; and how is the other engineering teaching done ?—*A.* It was done well by Professor Reilly.

530. What did he teach ?—*A.* Constructive engineering.

531. Who else is there ? What, for instance, does Mr. Heath do ?—*A.* Mr. Heath used to give lectures in descriptive engineering, but latterly he has been Instructor in Surveying.

532. *Sir Courtenay Ilbert.*—Instead of, or in addition ?—*A.* Sometimes a little in addition, but certainly the surveying has been done by him.

533. *Chairman.*—Then at present there is Dr. Brightmore, who does constructive engineering ?—*A.* Yes.

534. And you hydraulics and mechanics ?—*A.* Yes.

535. And Professor Heath ?—*A.* Surveying.

536. What do you mean by descriptive engineering ?—*A.* It is the part of the course which can be dealt with without mathematics. It is a description of the methods which engineers have of carrying out certain works without going into the estimation of the quantities. It is a general account.

537. *Sir William Preece.*—I suppose you would call a paper read at the Institute descriptive ?—*A.* Yes, except in so far as it was a calculation problem.

538. *Chairman.*—These three professors teaching engineering and educating the engineer, one of them does the constructive, one of them takes in hydraulics and one of them takes in descriptive engineering, whatever that is, and these three professors are working independently as I understand the present system ?—*A.* There are not three, there are two.

539. There are two, and Mr. Heath; is that it ?—*A.* Not Mr. Heath, Mr. Heath is doing surveying.

540. At present he is not doing the engineering, but quite recently he was ? —*A.* For two years before this session he has been Instructor in Surveying; including this session it would be three years.

541. Is Dr. Brightmore, and are you, independent so far as your lectures go?—*A.* We have separate parts of the subject to deal with, specified by our appointments.

542. Are you satisfied with this system; do you think it is a good system, or would you alter it in any way?—*A.* It is all right if the President takes the duty of seeing that they do not overlap, and that they fill up the subjects properly. If the President is not able to do it, or does not do it, it is not satisfactory.

543. What has been proposed now is to make one man the Professor of Engineering, and to give him an assistant who, under his orders and instructions, will take that part of the teaching which he asks him to take, and which he does not want to teach himself. Do you think that is a better principle?—*A.* It would work out in the end to the same, that this assistant would be given a certain part, and he would carry it on independently.

544. Do you mean that the chief man would wash his hands of it altogether, would not take any interest in it?—*A.* It would get more or less into that condition.

545. That was not always your opinion, was it?—*A.* That it would get like that?

546. It was not always your opinion that it would work out the same. I remember seeing a letter of yours in March 1899, in which you found fault with the existing system, and in which you proposed a re-organisation of the engineering staff?—*A.* I do not think there is any fault-finding in my letter.

547. It implied that?—*A.* It was submitted with a view to meet a difficulty which arose at the moment in the College.

548. That is all?—*A.* That was the chief reason.

549. You proposed that there should be a senior Professor of Engineering?—*A.* Yes.

550. That there should be a Professor of Engineering below him?—*A.* Yes, and two assistants.

551. And you said "that all the subjects above enumerated be treated as a "homogeneous whole, and that the Senior Professor of Engineering be "responsible for providing by himself and the other three members for all "the instruction in those subjects; the President's approval being obtained "to the arrangements he may make." That appears to me to go on the same principle as the one which the Board of Visitors has recommended the Secretary of State to accept, namely, that there should be one man who is responsible for the teaching of engineering, and that he should carry out that instruction by himself and his assistants.—*A.* Observe that I propose a second professor.

552. Yes, you call him a professor, but you say that the "Senior Professor "of Engineering be responsible for providing by himself and the other three "members for all the instruction in those subjects."—*A.* Yes. But I take it that this proposal in the Blue Book is a very different thing from that.

553. In what way, except that we do not call more than one man a professor?—*A.* The second man is a tutorial assistant.

554. He is called that?—*A.* Yes, that is a very different person from what I propose. I take it that the subject that has to be dealt with is chiefly applied mechanics, an extremely large and heavy subject, involving the theory of the strength and elasticity of structures and materials, the theory of machines, hydraulics, thermo-dynamics, and some other collateral subjects which have to be dealt with in a mathematical way. One man cannot do that subject properly, and I represent to you that Colonel Ottley's opinion, in which he speaks of that part of the subject which is not descriptive engineering as a mathematical subject to be dealt with by mathematicians, is entirely wrong and founded on misapprehension. His proposal to enlarge the teaching of mathematics is, I suppose, his notion of dealing with that part of the subject, but it will not thus be properly dealt with. The subject of applied mechanics should be taught by engineers who are qualified to teach the mathematical portion of the subject. We want a professor who is a man of responsibility and position and not merely a tutorial assistant.

555. I was not now going into the technical point. What I wanted to get at was this—that as a matter of re-organisation would you or would you not approve of one Professor of Engineering with assistants under him, calling them anything you like, professors or tutors, but with assistants, but

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so that one man should have the engineering education of the students in his hands to regulate?—*A.* It is desirable, if the President does not himself become the director of studies.

556. If he does not do it himself, you mean?—*A.* Yes.

557. Could he do it himself unless he took the chief part of the instruction in his own hands?—*A.* I must say I do not think Colonel Ottley could.

558. *Sir William Preece.*—Colonel Pennycuick tried?—*A.* He left at this stage, almost immediately after this letter of mine was sent in.

559. *Chairman.*—Do you think that the proposal that you made is in principle different from the proposal that is now made?—*A.* I do not know that it is entirely different in principle; it is entirely different in scope.

560. What I want to get at is whether it is one in principle?—*A.* That there should be one man at the head?

561. Yes.—*A.* If I had been in that position myself I should not have taken the responsibility for his portion of the work from the professor next to me.

562. I do not understand, you would not have taken the responsibility from the professor?—*A.* No.

563. You say the Senior Professor of Engineering is to be responsible for providing by himself and the other three members for all the instruction?—*A.* It is different from what is proposed in the scheme. If Dr. Brightmore is to have one man who is described as a tutorial assistant, it is putting the subject into a very small position as compared with the less important subject of mathematics, where there are two professors and perhaps two assistants.

564. *Chairman.*—It is a matter of position and of the man. I take it that your objection is that you want a bigger man than that for the second man, is that it?—*A.* Yes.

565. That is the ground on which you object to these changes; as a matter of criticism, apart from all personal reasons, as an outside critic would you say that the second man ought to be a bigger man?—*A.* Yes.

566. You do not really object to the actual principle of making one man responsible?—*A.* No.

567. Now, on personal grounds as to your own personal case, what objections have you to urge?—*A.* It is a very difficult position for me to have to assert that I am superior to Dr. Brightmore. I would like you to put yourself in communication with some other people who will be able to speak on that point. I think it is a very dreadful position that I should be put into to have to assert myself as against a colleague. I have had a long experience of teaching these subjects; I have got testimonials, and I do not think other people have got anything better, and that a man with no experience at all in teaching should be considered to be my superior on absolutely no evidence is, I think, somewhat monstrous.

568. Are we to understand that supposing the Secretary of State had asked Dr. Brightmore to retire, and had asked you to take the place of the chief professor, you would not have raised any objections to the remainder of the proposals?—*A.* I should have thought that they ought not to have asked him to retire after having just appointed him. Two men of eminence are wanted for that subject, if you are going to balance it at all with the other part of the teaching of the College. There certainly ought to be two to balance the two Professors of Mathematics. The subject of applied mechanics is absolutely ignored in the new curriculum. I have in my notes, which I would like to hand in, put forward my views in respect of that, and I would like to insist on its being regarded as of the utmost importance to recognise that if this subject is put into the inferior position, in which it appears to be according to Colonel Ottley's views, the reputation of the College will go down. I take it that the reputation of the College has been built up to a very great extent on the excellent teaching of applied mechanics.

569. Who was the teacher in applied mechanics?—*A.* Professor Reilly was the beginner, and he had Professor Unwin as the second professor. I succeeded Professor Unwin. We divided the work equally between us. With respect to Dr. Brightmore and myself Colonel Ottley remarks that Dr. Brightmore is debarred from teaching his strongest subject, hydraulics. I beg to lay before the Board of Visitors the following facts: Before the arrival of Colonel Ottley I approached Dr. Brightmore immediately on his appointment, with a view to effecting an interchange of some of the subjects of instruction. Having charge of the mechanical laboratory and the practical instruction in the strength and elasticity of materials,

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I was desirous of taking over the lecture portion of the subject, to which I had devoted considerable attention in my previous appointment at the Royal Naval College, in order that the mechanical laboratory course might be fitted into, instead of being merely added on to, the theoretical portion. I at the same time recognised that probably Dr. Brightmore would be more at home in giving instruction in water supply constructions, and I thought it desirable that the students should have the benefit of his special knowledge. Dr. Brightmore freely responded to this proposal, and when Colonel Ottley arrived he was asked by both of us to sanction the change. At first he demurred, saying he would like to have time to consider the matter, and when he was afterwards pressed by both of us to allow the exchange he refused. I have also been debarred from teaching one of my strongest subjects. It would have been an excellent exchange.

570. Would you like to put your papers in?—*A.* Yes. I would like to point out that the reason alleged in the Blue Book—that is the only thing I have to go upon—for the retirement of Mr. Heath and myself was to effect a saving.

571. You had better leave Mr. Heath's case alone.—*A.* Mr. Heath and myself are put together and are retired for the purpose of saving 835*l.* a year as alleged, whereas as a matter of fact there is a loss of 38*l.* a year, so that the reason for our retirement absolutely falls to the ground.

572. If you put your statement in it will appear on the proceedings.—*A.* Will you allow me to make a statement on behalf of my assistant Mr. P. Reilly? I think I ought to be allowed to make a statement for him as he cannot thus speak for himself.

573. We cannot allow you to go into that.—*A.* He is my assistant.

574. He went very fully into his own case.—*A.* I desire to record my appreciation of Mr. P. Reilly as a most careful and reliable worker. I will hand these papers in. (*Papers handed in.*)

575. *Sir John Wolfe Barry.*—I take it, therefore, in what you have said that you are of opinion that Dr. Brightmore could not do the work which he is anticipated to be able to do if the tutorial instruction is given by assistants in the way that Colonel Ottley suggests?—*A.* Yes.

576. He cannot do the work efficiently?—*A.* I have made a timetable representing what he has got to do. He has got the responsibility for all the work shown on this table (*producing same*). He has got to do all shown in black ink personally. No man could do it; if he had any amount of mental capacity he has not got the physical strength to carry it out.

577. Have you consulted Dr. Brightmore on this question?—*A.* No, I am sorry to say that we are not particularly good friends. Dr. Brightmore was always very reticent, and recently I am afraid that he has rather detached himself from the rest of the staff. I really do not know him. I have had little or no opportunity of making myself acquainted with him, and I assure you it has been through no fault of my own.

578. Broadly speaking, I think we may take it that your view of the whole situation is that the suggestions which are made in the Blue Books cannot be carried out with efficiency by the College unless there is more professorial teaching, assuming that the assistance which Colonel Ottley wants in tutorial instruction is given?—*A.* Yes.

579. You look upon the assistants that are talked about as mainly tutorial?—*A.* It is so expressed.

580. Look at page 24. Colonel Ottley says, "I have not the smallest hesi-
"tation in saying that Dr. Brightmore is perfectly capable of teaching the
"whole of the above subjects, and that, but for the difficulty of affording
"'tutorial' instruction to so large a class as, say, 40 or 50 students, he
"could easily teach the whole subject single handed. Owing to this diffi-
"culty, however, it would be necessary to allow him an assistant who could
"help him to give the necessary tutorial instruction in the manner usual at,
"say, the Royal Military Academy. There would be no difficulty whatever
"in finding a suitable assistant to Dr. Brightmore on 450*l.* a year, and in
"this case the combined emoluments would amount to 1,150*l.*, or a saving
"of 835*l.* a year, whilst, in my judgment, the work would be done better,
"and more satisfactory results would be secured. Dr. Brightmore and his
"assistant would then each have an average of 24·62 hours' work per
"week, including class and laboratory work. This amount will, I think, be

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"held to be sufficient, but not excessive." Your opinion differs entirely on that point?—*A.* I think he very much underrates the importance of the subject, and does not satisfy at all what is required for the teaching of that subject to balance it with the rest of the teaching.

581. *Sir Alexander Rendel.*—You have drawn out a scale, I see; how many hours a week is he employed on your scale?—*A.* According to this he is employed from half-past 8 continuously till 3 or 4 o'clock, taking one class after the other, with just the luncheon interval. He does that on Monday, Tuesday, Wednesday, Thursday, Friday, and Saturday, with the exception of Friday in the winter half of the year, when he has one hour off from 10.10 to 11.10, and he is off also on Saturday from 9.50 to 10.50 and completes at 12.

582. How many hours a week does that come to?—*A.* Over 30.

583. *Sir William Bisset.*—Do I understand you that that table is made out on the supposition that Professor Brightmore is to do the whole of the lecturing himself; that is to say, that both he and his assistants are to be present concurrently at all the lectures?—*A.* I have not been able to separate them.

584. That they are to be both together with each class?—*A.* There are some times when there are two courses going on, so that they could not be together. That occurs three or four times in each week.

585. *Sir Alexander Rendel.*—You make it about 30 hours a week?—*A.* Yes.

586. When we were electing a candidate for the place which Dr. Brightmore holds, I put a question to one of the candidates, who came from the Yorkshire College, I think, as to the number of hours he was in touch with his pupils during the week, and he told us six hours a day for five days a week, and three hours on the Saturday, which meant a 33 hours' week; he did not seem to talk of that as being anything in excess.—*A.* Being in touch with them is a different thing from having to lecture successively and keep them at work. Even when not lecturing one has to keep talking and urging; that is as I work, and, to do this, changing from one class to another class, keeping the three years going practically the whole of each day, is too exhausting to be successfully accomplished.

587. Would the master of a public school not be doing more?—*A.* Take the difference in the character of the work. One has besides to provide the piece of work for them to do. It takes hours to do that.

588. *Sir John Wolfe Barry.*—How many lectures a day have you got down for Dr. Brightmore; the most?—*A.* Four. I cannot make more than four, because there are not more than four divisions.

589. Four lectures a day?—*A.* Yes.

590. *Chairman.*—Might I ask what is the authority for this table that you have prepared?—*A.* This is prepared merely by taking Colonel Ottley's time-tables, putting the three years together, and taking only Dr. Brightmore's work, leaving out everything else.

591. Have you shown it to Colonel Ottley, in order to see that it is correct?—*A.* I have not shown it to Colonel Ottley.

592. *Sir John Wolfe Barry.*—Perhaps you had better put it in.—*A.* Yes, I will do so. This shows that it is an impossible quantity of work for him to do. (*Table handed in.*)

593. At any rate we may take it in this way—that you would not consider yourself qualified to teach the whole subject with such a number of hours?—*A.* I certainly would not like to take the responsibility of doing it; I could do it as well as Dr. Brightmore, I know.

594. In all branches?—*A.* In all branches—and better, I have no hesitation in saying.

595. *Chairman.*—You have had practical experience of engineering works, I believe?—*A.* I have had practical experience.

596. Have you carried out large works?—*A.* No, I have not had the opportunity of carrying out large works. I have here a letter respecting the shifting of the laboratory which I should like you to see.

597. Are you responsible for the laboratory?—*A.* I am responsible for the laboratory. This letter I wrote to Colonel Ottley concerning the shifting of the laboratory and the testing machine into a new building. He has not acknowledged the receipt of it, but I think it is an important letter.

598. *Chairman.* You can hand it in, but I cannot promise to put it on the record without looking at it?—*A.* Very good, sir. (*Letter handed in.*) *Prof. Hearson.*

599. *Sir William Preece.* We do not want to introduce personal matters. —*A.* It contains nothing personal; it is a bit of information.

The witness withdrew.

Mr. ARTHUR HENRY HEATH called and examined.

600. *Chairman.* What are your degrees?—*A.* I have no degrees. *Mr. A. H. Heath.*

601. I believe you are an Associate Member of the Institute of Civil Engineers?—*A.* Yes, I am.

602. What is your age?—*A.* My age is nearly 55.

603. When were you appointed to Cooper's Hill?—*A.* In August 1875.

604. Previous to that where had you been employed?—*A.* On the Great Northern Railway.

605. In what capacity?—As an assistant engineer.

606. On what terms were you appointed to Cooper's Hill?—*A.* As an Assistant Professor of Engineering.

607. On what terms, as to notice or pension—briefly, did you hold the appointment as long as you satisfied the President?—*A.* Yes.

608. But subject to one term's notice on either side?—*A.* Yes, without reason assigned.

609. Your appointment was pensionable under the Superannuation Act, was it not?—*A.* Yes, under the Civil Service Superannuation Act.

610. Your salary was 450*l.* a year?—*A.* Yes.

611. With fuel and gas, and house?—*A.* Yes.

612. I believe the house was not part of the original terms?—*A.* No; it was promised verbally by Colonel Chesney.

613. What subject have you taught?—*A.* I have taught what is called descriptive engineering.

614. Have you taught that the whole time?—*A.* Yes, with the exception of the last two Sessions, and the present Session.

615. How many hours of the week have you been teaching?—*A.* My lecture work has been oral lectures; generally about an hour and a half to each year per week.

616. That would work out to about 4½ hours?—*A.* Yes, but then there was also in one term the forest students; I lectured to them.

617. What on?—*A.* On road construction and forest engineering; so that altogether my hours worked out to 4·83 per week; that is about the average.

618. Is that all the work that was exacted from you?—*A.* No, very far from that.

619. What other work is there?—*A.* A part of the major portion of my work is the project surveys and the project course drawings, for which marks are assigned after minute examination.

620. What do you mean by the project survey?—*A.* The third-year students are divided up into parties of four members to each party, and they are sent out into the adjoining country to select a line of route for about two miles of railway, or road, or canal. They proceed to examine the ground, take trial sections, and then finally set out a centre line, take longitudinal sections, cross sections, and so on, and make a complete project for a road, a railway, or canal. That occupies about six weeks.

621. Is there one standard project that has been coming along for all this time, or do you vary the country and the project?—*A.* We go over the same country; we must necessarily do so, because we have permission to go over certain ground only.

622. So it has been the same project all along?—*A.* But different men, of course.

623. But still it makes a great deal of difference in the work of dealing with it?—*A.* No, that is not so, because the same centre line is not taken every year. It is a varying centre line. Each party selects its own centre line; therefore, although we go over the same country it is not the same work.

624. How much do you think that occupies you—how long?—*A.* That occupies six weeks.

Mr. A. H. Heath.

625. In each year or in each term?—*A.* In each year, in the Autumn term.

626. *Sir John Wolfe Barry.* What do you mean by six weeks; is it six weeks of six days a week?—*A.* They are out five days in the week, and they consult me on the sixth.

627. How many hours?—*A.* From half-past 8 till about half-past 6, or thereabouts for the five days.

628. The whole day?—*A.* Yes.

629. And a long day?—*A.* Yes.

630. *Chairman.* Are you out with them that time?—*A.* Yes, I am visiting the parties. That lasts for three weeks, and then they are three weeks indoors making the plans, &c., and the students come to consult me. I am indoors for perhaps six or seven hours every day for those three weeks. The assignment of marks for the plans, &c., is an additional lengthy process.

631. Have you any other duties?—*A.* Yes, another of the major portions is that I have to send the first-year students to brickfields and to ironworks, and there is a good deal of correspondence and writing letters of introduction in connection with that.

632. Arranging for these facilities?—*A.* Yes.

633. How many students would there be sent?—*A.* From 35 to 45, not more than that—about 40 perhaps; it depends, of course.

634. They go to the same brickfields generally, I suppose?—*A.* Some go to the same brickfields, but they are told to go to the brickfields near to which they live. They go also to ironworks.

635. They do that in the summer vacation?—*A.* Yes.

636. Your work in relation to that is merely the correspondence connected with it, is it not?—*A.* No; they are instructed to make notes as to what they have seen. These notes are written in note books, and then they are submitted to me for valuation. I have to read them through carefully and assign marks in the competitive college course.

637. *Sir William Bisset.* Descriptive engineering, as I understand you, does not deal with the mathematical side?—*A.* I do as far as practicable deal with that side in connection with the subject, but there are two professors of mathematics and two professors of applied mechanics who deal with that side, so my dealing with it would be to some extent superfluous.

638. *Sir Courtenay Ilbert.* Has there been any change in the character of your work recently?—*A.* Yes.

639. Has the surveying been substituted in any way for the descriptive engineering, or is it in addition to that?—*A.* It is now the chief part of my work.

640. And partly in substitution?—*A.* Yes.

641. That is to say you do not do so much descriptive engineering as formerly?—*A.* No.

642. But you do surveying as an addition?—*A.* Yes.

643. Is your surveying the work which you were describing just now?—*A.* No, that is the project course. Surveying is in addition.

644. *Chairman.* You mean the teaching of surveying?—*A.* Yes, what we call the survey course. I have been teaching that as well as the third-year project, and the design of a railway station with the interlocking of signals and so forth, and also the assignment of marks to the reports on the visits to ironworks, &c.

645. *Sir Courtenay Ilbert.* The survey course is in substitution for part of your previous descriptive engineering work?—*A.* Yes.

646. *Chairman.* Who has taken the part that you dropped?—*A.* I believe Dr. Brightmore takes that.

647. *Sir John Wolfe Barry.* I presume you mean by descriptive engineering the mode of construction of structures and the nature of materials?—*A.* Yes.

648. Apart from any mathematical calculations?—*A.* Yes, to a large extent.

649. *Sir Alexander Rendel.* How to put in a bridge pier, for instance?—*A.* Yes.

650. Would you take the girder work and that kind of thing?—*A.* No, that belongs to applied mechanics, but I did lecture to the men on the use of iron and steel in construction.

651. You took foundations—they would be distinctly your business?—*A.* Yes; and pile work and earth work of all descriptions.

652. *Sir John Wolfe Barry.* Road making?—*A.* Road making and railway construction.

653. That is now being done by Dr. Brightmore.—*A.* Yes, I believe so.

654. You are doing surveying and this course of projects?—*A.* Yes, surveying, plus the projects and plus the railway station design, and the ironworks, &c. note books.

655. *Chairman.* How long is it since you were asked to do the surveying? *A.* When General Courtney retired in July 1898, Colonel Pennycuick asked me in September 1898 to take up the surveying course, and I carried through that course for that Session, 1898-99, under my sole charge as Professor of Surveying.

656. Did you do that willingly?—*A.* Yes, and Colonel Pennycuick thanked me in public for my services afterwards.

657. *Sir Alexander Rendel.* You know the great method of foundation in India is by wells?—*A.* Yes.

658. Did you put them through a course of instruction in well sinking?—*A.* Yes, a very complete course of foundation work.

659. *Sir John Wolfe Barry.* I see Colonel Ottley says with regard to the surveying that—"It is impossible for one man to teach this subject; "two at least are necessary, because, although 'divisions' (or, say, 24 men) "are dealt with, no instructor can properly manage more than about 12 men "as a *maximum* in the field." Do you agree with that?—*A.* I did manage to teach surveying to 21 men at a time, but it was by organising them in small parties, each party being responsible for a certain piece of work.

660. Colonel Ottley also says in the Blue Book: "'Surveying' used to be "one of the strong points of the Cooper's Hill course. Of late it has fallen "behind; the time devoted to it has been reduced, as has also been the "staff." Has the staff been reduced in your time?—*A.* Yes, it was reduced to one only. In General Courtney's time there were two.

661. And since that time you have been alone?—*A.* No, now there are two again.

662. Is that somebody acting under you?—*A.* We are acting together.

663. Who is that?—*A.* Mr. Woods.

664. *Chairman.* Mr. Woods took it up?—*A.* Yes, he was instructor with General Courtney, the Professor of Surveying.

665. You said you willingly took it up. At the beginning of last year Dr. Brightmore, thinking that you were an assistant, and therefore more or less under his orders, asked you to take a surveying course; you did not exactly express willingness then, I think?—*A.* That was not the point raised; the question was that according to my letter of appointment, I was an Assistant Professor of Engineering—not assistant to the Professor of Engineering; and that was the nature of my query. I considered it an alteration in my status at the College.

666. You protested against it?—*A.* I protested against that, not against doing the surveying.

667. You thought you had been treated in a very unjust manner, I think you said?—*A.* Yes, I did.

668. Whatever surveying you have done now has been under Colonel Ottley's orders?—Yes.

669. You think that you are not in the position of assistant to Professor Brightmore?—*A.* The India Office has issued orders that it is to be so.

The witness withdrew.

Adjourned till Tuesday next, the 19th instant at 4 o'clock.

MINUTES OF EVIDENCE

TAKEN BEFORE THE

BOARD OF VISITORS AT THE INDIA OFFICE,

ON

Tuesday, 19th March 1901,

IN REFERENCE TO THE

Remodelling of the Studies and the Retirement of certain of the Professors and Lecturers.

SECOND DAY.

Present:

SIR CHARLES H. T. CROSTHWAITE, K.C.S.I., Chairman.
SIR JOHN WOLFE BARRY, K.C.B., F.R.S.
MR. HUGH LEONARD, F.S.A.
MR. JAMES MANSERGH.
SIR W. H. PREECE, K.C.B., F.R.S.
SIR W. S. S. BISSET, K.C.I.E., R.E.
SIR ALEXANDER M. RENDEL, K.C.I.E.
SIR COURTENAY P. ILBERT, K.C.S.I.

Colonel J. W. OTTLEY, C.I.E., President of the College, called and examined.

Col. Ottley

670. *Chairman.*—The Board of Visitors have asked you to attend, as they have a few questions to put to you.—*A.* There is one point I should like to refer to, if I might be allowed to make a remark or two before you commence. Great exception has been taken to my action in the matter of the service of the original notices. I should like to explain to the Board of Visitors that absolutely the furthest thing from my thoughts was to do anything abrupt or harsh, or to in any way hurt anybody's feelings. But the fact is that the thing had to be done in an extraordinary hurry. I received the notice, I think, on the Sunday morning, and I understood that it ought to be in the hands of the gentlemen concerned, on the Monday. I did not quite know how to set about this. I had one copy of the Secretary of State's letter, and I did not see my way to writing a separate letter to each gentleman; and therefore I had the letter typed with multiple copies, and I merely wrote a formal forwarding docket, without in the least thinking that anybody could take exception to it. I looked upon myself, rightly or wrongly, as a post office in the matter. I quite see, from the comments that have been made since, that

Col. Ottley.

it would have been very much better if I had written separately to each individual, as indeed I did in the second case. When the second letter came from the Secretary of State, I wrote with my own hand a separate letter to each individual, and tried as far as I could to give no further cause for offence. That I succeeded, I think you will find from some of the cases. For instance, I think in the Blue Book you will find a letter from Mr. Heath, in which he thanks me for my very cordial and appreciative letter, or words to that effect. Most of the others did the same. Some did not answer at all, but most of them appeared to have appreciated my action. I only wish to say now that I am exceedingly sorry I did not write similar letters in the first instance, but at the time I really did not think it was necessary.

671. *Mr. Leonard.*—Why was it necessary that it should go out in such a hurry?—*A.* I understood that one term's notice must be given, and it was actually at the end of the term. I think it was within a day of the end of the term, as far as I remember, so that if it had not been given then it could not have been given for another term, and this would have meant six months instead of three.

672. *Chairman.*—You are the President of the Royal Indian Engineering College?—*A.* I am.

673. Since how long have you been President?—*A.* I think I joined about the latter half of October 1899. I forget the exact date, but it was after the middle of the month.

674. When did you make proposals for alterations in the staff, and in the system of teaching?—*A.* As far as I remember it was about the middle of the following June.

675. On the report in which you made those proposals were based the recommendations of the Board of Visitors which are now under discussion. Will you tell us exactly what your recommendations were as to the staff of the Engineering Department? At the time it consisted of Dr. Brightmore, Professor Hearson, and Mr. Heath—three men?—*A.* Yes, quite so.

676. Those three men were, as I understand, acting more or less independently?—*A.* They were.

677. None of them was under the other?—*A.* Mr. Heath had been placed under the orders of the Professor of Engineering, but he disputed the position, and therefore the correct answer would appear to be "No."

678. Or, as far as teaching went, in communication with the other?—*A.* I believe that is so.

679. What was your proposal?—*A.* My proposal was that the Engineering Branch should be worked by two men, one being considered to be the principal professor or teacher, and the other working in subordination to him, possibly in many cases taking separate branches, but at the same time working in subordination, there being one head, and the assistant working with the principal.

680. As to the timetable which you drew up for carrying out that proposal, did you consult Dr. Brightmore in drawing it up?—*A.* I did.

681. Had you his full concurrence in your proposed timetable?—*A.* Yes. As a matter of fact the timetable was based on the number of hours laid down by Dr. Brightmore. Dr. Brightmore worked out a syllabus which was subsequently discussed by Mr. Woods, Dr. Brightmore himself, and myself, at various times. Against each of the branches in the syllabus Dr. Brightmore had put down the number of hours that he considered necessary for that particular subject. In drawing out the timetable I worked to that as far I possibly could. At the end of the syllabus were given the number of hours that he required in each year for the students. That was the basis of my table. I have since worked out the timetable with him and with Mr. Woods, and I am perfectly satisfied that, so far as it goes, it can be worked to. I do not mean to say that it may not be improved, or that it may not be changed. If I might be allowed to give one instance, in the syllabus as originally laid out by Dr. Brightmore, and in the timetable as made out in connection therewith, we went rather on the principle which is obtaining at present in the matter of the mechanical laboratory, which has been worked entirely in the third year. Since then Dr. Brightmore has suggested to me that it would be much more satisfactory if the work in the mechanical laboratory were carried on *pari passu* with the theoretical instruction, working at the same thing in both cases. For instance, where

you have got to deal with the strength of materials, it is much better that you should have the theory in the lecture room and then go into the laboratory and do the practice at the same time, instead of having an interval of two years. Therefore, I say in that way the timetable, as laid down originally, is subject to change and probably could be very considerably improved.

682. I suppose it is by no means a stereotyped timetable?—*A.* No, it is not.

683. You always reserved to yourself power to alter it?—*A.* Certainly. It is only put down as a suggested timetable, and of course if anybody can suggest an improvement I should be only too happy to listen to suggestions.

684. Did Dr. Brightmore express any doubt as to his capability of teaching up to that timetable?—*A.* None whatever. I should like to say one thing, because it rather hinges on this question, and that is, that when I joined Cooper's Hill as President I was asked whether I would undertake teaching, and I said, "Certainly not; under no conditions will I bind myself down to teach." That was the understanding on which I obtained my appointment; but I wish to tell the Board that since then I have seen reason to think it would be very desirable that I should teach, and I have made up my mind, in connection with Dr. Brightmore and Mr. Woods, that I should take the whole of irrigation engineering, a subject in which I may say that I have had very considerable practice. Possibly, as a canal engineer, I have designed more works than most Indian Engineers. I was responsible for the remodelling of the Bari-Doab Canal; the revised project for the Chenab Canal, which has been completed, and is one of the most successful projects, that the Government has ever undertaken; the Jhelum Canal, which is now in progress; the headworks of the Mandalay Canal in Burmah; the headworks of the Jamrao Canal in Scinde; and since I left the service I drew out the preliminary project for the Montgomery Canal from the Beas, which the Government are now about to put in hand. I have of course been connected with a number of smaller works, but those mentioned are all large works running into large figures.

685. *Sir William Preece.*—Were you not a Royal Engineer?—*A.* My training was rather a curious one. I was trained originally as a civil engineer as a pupil of James Berkley's, who was the Chief Engineer of the Great Indian Peninsula Railway in 1858. When I came home with him I went on to Mr. Benjamin Piercy's lines in Wales, and it was whilst waiting for an appointment in Spain that I went up for the open competition at Woolwich and passed in. I then got my commission as a Royal Engineer and went out to India again in 1868. I started therefore as a civil railway engineer, then became a Royal Engineer, and finally became an irrigation engineer in January 1870. That is my history.

686. *Mr. Mansergh.*—When did you join the Royal Engineers?—*A.* In January 1864.

687. *Sir Alexander Rendel.*—In reference to canal engineering, do you propose to teach it descriptively or mathematically?—*A.* I shall take up the whold subject of irrigation canals.

688. You will give the mathematics of it, and not confine yourself to the mere designing?—*A.* I shall deal with the whole of it. I shall take the subject of canal engineering, both theoretically and practically; Mr. Woods will take railways and also sewage schemes which he has made a study of, and Dr. Brightmore proposes to take water supply, for which he has special qualifications.

689. *Chairman.*—We have not had Mr. Woods's name before us in this connection hitherto, have we?—*A.* I think he is mentioned in my report, as being the man marked out to be the assistant to Dr. Brightmore. Mr. Woods is an old Fellow of Cooper's Hill, and has got splendid certificates. He has kept up his mathematics to the present day. I should like to say this: The three of us will carry out the engineering training in the sense I have explained, but in my original report I laid down merely the two, Dr. Brightmore and Mr. Woods., I have no doubt whatever that wo could do the work; and for this reason, that Mr. Woods and Professor Hearson actually, during the whole of the session 1898–99, did carry out the whole of the work; that is to say, Professor Hearson did the hydraulics and machine construction, and Mr. Woods did the whole of Professor

Col. Ottley.

C. Reilly's work and Mr Heath's work. What was done in 1893-99 can be done again.

690. *Sir William Bisset.*—In Professor Hearson's evidence, I think it was, a statement was put in that the timetable referred to was made out on the supposition that Dr. Brightmore is to do the whole of the lecturing himself; that is to say, that he and his assistant are to be present concurrently at all the lectures. That was an assumption which I made from Professor Hearson's statement. He said that he had not been able to separate them. Then I asked, "They are to be both together with each class?", and he replied, "There are some places where there are two courses going on, so "that they could not be together. That occurs only three or four times in "each week." That was with reference to a statement by Professor Hearson that the two officers would not be competent to do the work because they had not got the time?—*A.* According to this particular timetable, do you mean, or that it could not be done with any other timetable?

691. That it could not be done, as I understood?—*A.* In 1898-99 it was done, as a matter of fact, throughout the year, but not, of course, on this timetable.

692. *Mr. Leonard.*—You will really have three lecturers or professors on engineering if you take up one of the branches?—*A.* Quite so. On this question of the number of hours during which the professors of engineering will be engaged, I have taken out the figures from the timetable. The average number of hours per week will be 16 hours lecturing, 17 hours on examples in designs, and 9 hours in the mechanical laboratory; that is, a total of 42 hours in all. That we generally propose to divide up, as the timetable stands at present, by giving 19¼ hours to Mr. Woods, 19¼ hours to Dr. Brightmore, and 3½ to myself for the week. It will probably be possible to re-arrange the hours hereafter, so as to equalise the work better in the two halves of the session. It will be a case of give and take. I think there will be no difficulty about doing it; at any rate, I see no difficulty. I have discussed it with Mr. Woods and with Dr. Brightmore, and I have no reason to suppose that it is not a workable scheme.

693. *Sir Alexander Rendel.*—Then you do not agree with Professor Hearson in that?—*A.* If he said it cannot be worked I do not agree with him. I only take 3½ hours per week, so that you may throw me out of the question altogether and deal with it practically as the work of two men only.

964. Professor Hearson says:—"No man can do it; if he had any amount of mental capacity, he has not got the physical strength to carry it out."—*A.* It depends what we are talking about. As a matter of fact it works out to about 3½ hours a day, or, at the outside, four hours a day. It is not lecturing only; even at the busiest time of the year only 17 hours out of 47 are spent in lecturing, the remainder being taken up in working designs and examples and seeing the students work them, and in the mechanical laboratory, going through the mechanical tests. The 47 hours a week is the maximum number of hours in any week in the year, and, as above said, the averageis 42.

695. *Mr. Mansergh.*—Between the two men?—*A.* Between the three, as it includes my 3½ hours.

696. *Sir William Preece.*—You say that you took office at Cooper's Hill in October 1899, and that you submitted a report to the Secretary of State which was referred to us; that report was dated 13th June, was it not?—*A.* Yes.

697. On 24th July we reported upon it. I presume that from October of 1899 to June of 1900 you devoted practically your whole time to investigating the work of the College and making yourself personally acquainted with all the professors and discussing with them the scope of their duties and their work there?—*A.* That is so.

698.—Your report was really prepared after the discussion of all these points with the professors?—*A.* With many of the professors. With some there was not very much opportunity for discussing matters, because they did not lend themselves to any discussion. I would name especially Professor Hearson himself. On two or three occasions I spoke to him about his turbine design, but he took such very great exception to any remark that I made on the subject, and was so overbearing about it, that I very soon dropped any discussion with him at all. It was perfectly useless; he simply overrode me at once. For instance, I had been talking to the mathematical

professors, and told them I had found that Colonel Pennycuick had said that some more mathematics were required. I asked them their opinion upon the subject, and found that they entirely agreed with me that mathematics should be carried on into the third year instsad of being dropped at the end of the second year. Shortly after this, Professor Hearson came up to my room and asked me whether it was the fact that I proposed to lengthen the mathematical course. I explained that such was the conclusion I had come to. He told me that I was entirely wrong, and more than hinted that I did not know what I was talking about. In short, he made himself so disagreeable that I told him that I should prefer not to discuss the question with him at all. *Col. Ottley.*

699. In the letter that Sir William Anson wrote to Lord George Hamilton, he says: "We urge that there was something amiss in the constitution of the "College if men who had served there for many years, and who are not "alleged to be incompetent or unwilling to teach, were deprived of all "opportunity of a hearing, when the President recast the course of studies "in which they were concerned in such a way as to involve proposals for their "dismissal." Of course, no one would for one moment expect that the president or the headmaster of a college or the headmaster of a school would consult those who he had made up his mind were not fit for their work?—*A.* Quite so.

700. But before you came to the conclusion that they were unfit for their work did you take every precaution yourself to decide in your own mind whether they were qualified for their duties or not?—*A.* Yes; not so much as to whether they were fit for the work that they were actually doing at the time, but as to whether they were fit for the work as I consider it ought to be done.

701. Just take your timetable. In determining the weekly hours for physics and practical physics and chemistry and practical chemistry, did you at all discuss the work to be done with Professor Stocker and Professor McLeod?—*A.* I did not discuss it in connection with physics. What I did with Professor McLeod was that on several occasions I told him that I thought there was a great deal too much chemistry. That was an opinion which had been come to by my predecessor as well.

702. That is what I want to lead you to, because I think all of us—certainly myself personally—have come very strongly to the opinion that on this timetable there is too much chemistry and too little physics, and that while seven hours of chemistry are given to the third-year men, not a single hour is given to physics. We think, and others think the same, that if it were possible to recast the hours devoted to physics and chemistry, if any hours are taken away from chemistry they ought to be devoted to physics. Would you agree with that?—*A.* I entirely agree with it.

703. What opinion have you formed yourself of Professor Stocker?—*A.* Professor Stocker is a personal friend of mine, but you have asked me whether I had discussed the question with Professor Stocker. I did not go very deeply into it, for this reason: that when I took up this question, I said to Professor Stocker, that the work, so far as I saw it, was not sufficiently practical, and that it seemed to me that the course was a purely academic course. He laughed and said that he and I were not on the same platform in this matter, as his inclinations were wholly on the scientific side, whilst he took little or no interest in the practical side. I replied that we would agree to differ, as for my part I only cared for science just in so far as it would be useful in practice. He is, however, a most excellent teacher, and I personally should very much like to see Professor Stocker kept on.

704. That is what I wanted to put to you. I should like really to see if there is a means of keeping him.—*A.* I should very much like to see Professor Stocker kept on, but of course he would then have charge only of the "Physics" branch, and he would have to work it single-handed. I do not think that he requires a demonstrator to work it with him. He has got assistance in the laboratory, and he would not be overburdened with it. He could take up physics apart from electro-technology. I should propose to make that an entirely separate subject quite apart from Professor Stocker.

705. I will not say that is the view of the Board, but that is entirely my personal view.—*A.* That is my view distinctly.

706. Then we also had evidence, and strong evidence, before us the other day, that there was a great want of definition of responsibility between those

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who had the charge of the different branches. Take, for instance, physics, electrical engineering, and telegraphy. Professor Stocker is the head of the Department in which those three things are taught. Mr. Shields wanted to point out to us that he was perfectly competent to teach all three, but when we came to ask him who was responsible, we could only get him to acknowledge that he was responsible for the physical laboratory. He declined responsibility for telegraphy, and he declined responsibility for electrical engineering. Professor Stocker took the responsibility for the whole. The point I want to urge is, that from the evidence which we had the other day, there is clearly a want of definition of responsibility on the part of the different professors. We will pass from that. There was also a question brought up here the other day about the combination of the laboratory and the workshops; they tried to make out that it was a mistake. I am not quite sure whether it was Professor Hearson or another witness. Would you mind giving us your view of the combination of the laboratory and the workshops?—*A.* I proposed it myself. I came to the conclusion that it was the only sensible thing to do.

707. *Sir William Bisset.*—A witness said they were very large workshops, and I said to him that they were two buildings, separated by about 100 yards, what is the size of them? and he replied that the workshops and mechanical laboratory was about 100 feet by about 50 feet, and the workshop proper was probably 150 feet by 50 feet, and they have got a few machines in each.—*A.* I think it is the right thing to do to combine them.

708. *Sir William Preece.*—You are quite convinced yourself that it would be to the advantage of the College to combine these two?—*A.* I am quite sure of it.

709. And that it would be easily worked?—*A.* I am quite sure of it.

710. *Sir Alexander Rendel.*—I rather want to put to you a question about Mr. Shields. It seems that Mr. Shields is to be discharged because the teaching of telegraphy is found by Indian experience to be ineffective. Is that due to the ineffectiveness of the teacher, or to the ineffectiveness of the taught? Is it Mr. Shields' fault, or is it the fault of the students?—*A.* I thought you said he did not acknowledge any responsibility as regards teaching.

711. He did not disclaim responsibility for doing his duty or for not being able to do his duty, but he puts Professor Stocker as being his senior.—*A.* It is a little difficult for me, not being an expert in electrical technology, to answer the question you are putting.

712. *Sir Courtenay Ilbert.*—What was the post to which Mr. Shields was originally appointed?—*A.* That of demonstrator in the physical laboratory.

713. Do you consider him fit for that post?—So far as I know.

714. Should you consider him fit for the post of principal instructor of electrical engineering in the College, if such a post were created?—*A.* I would reply to that that, judging by the Indian reports on the training of the telegraph men, I am inclined to think that I would not recommend him as the principal professor.

715. Professor Hearson said the other day that before your arrival, but immediately on the appointment of Dr. Brightmore, he approached Dr. Brightmore with a view to effecting an interchange of some of the subjects of instruction. Professor Hearson was desirous of taking over the lecture portion of the subject connected with mechanical laboratory instruction, and he, at the same time, "recognised that probably Dr. Brightmore would be more at home in giving instruction in water supply constructions." He therefore proposed an exchange. Professor Hearson goes on to say: "Dr. "Brightmore freely responded to this proposal, and when Colonel Ottley "arrived he was asked by both of us to sanction the change. At first he "demurred, saying he would like to have time to consider the matter, and "when he was afterwards pressed by both of us to allow the exchange, he "refused." Have you anything to say to that statement?—*A.* I believe that he is absolutely mistaken. I am sorry that I did not know that this question would be raised, because I think I have got three letters from Dr. Brightmore bearing on this question. I am very nearly certain that the question was raised by Dr. Brightmore long after I joined. I think it may have been, I am not sure that it was not, as late as the middle of last year.

Professor Hearson, to the best of my knowledge, has never spoken to me on the subject, and I have also got it in writing from Dr. Brightmore that Professor Hearson never came to any final agreement with him. The question was apparently unsettled in Professor Hearson's mind; he had not settled what he did want, and they had never come to any final conclusion at all. I think I have got documentary evidence to prove that. *Col. Ottley.*

716. *Chairman.*—Professor Hearson, in his evidence, was asked by us whether he had consulted Dr. Brightmore as to whether Dr. Brightmore was able to do what is put down for him in the timetable. Professor Hearson had said that no man could do the work, and thereupon he was asked by Sir John Wolfe Barry, "Have you consulted Dr. Brightmore on this subject?" He said, "No; I am sorry to say that we are not particularly "good friends. Dr. Brightmore was always very reticent, and recently "I am afraid that he has rather detached himself from the rest of "the staff. I really do not know him. I have had little or no opportunity "of making myself acquainted with him, and I assure you that it has been "through no fault of my own." When Dr. Brightmore was appointed, were you at the College?—*A.* No, he joined at the beginning of the session, and I did not join for, I suppose, a fortnight or three weeks afterwards.

717. I was not sure whether Colonel Pennycuick had left before he joined?—*A.* Colonel Pennycuick had left, and Professor McLeod was carrying on the duty of President from the beginning of the session till the time I joined, I think for about three weeks.

718. But you had not come when Dr. Brightmore joined?—*A.* No, I had not.

719. Did you find that the relations between Professor Hearson and Dr. Brightmore were bad when you came; was there anything to show that they were on bad terms with each other?—*A.* Nothing especially came to my notice at the time. You see they were all strangers to me, and I did not know the politics of the place at all when I joined.

720. *Sir John Wolfe Barry.*—In your report on page 24 of the Blue Book you say, "I have not the smallest hesitation in saying that Dr. Bright-"more is perfectly capable of teaching the whole of the above subjects, and "that, but for the difficulty of affording the 'tutorial' instruction to so "large a class as, say, 40 or 50 students, he could easily teach the whole "subject single-handed. Owing to this difficulty, however, it would be "necessary to allow him an assistant, who could help him to give the neces-"sary tutorial instruction in the manner usual at, say, the Royal Military "Academy." Then you go on to deal with the financial position; and you add, "Dr. Brightmore and his assistant would then each have an average "of 24·62 hours' work per week, including class and laboratory work. This "amount, will, I think, be held to be sufficient, but not excessive." Do you still adhere to that view?—*A.* Yes. The tutorial work is necessary in a great many cases where you have not merely a lecture proper, but where you have working out examples and designs, and so on. Perhaps the word "tutorial" is not a good one, "individual" perhaps would be better. I think there is no difficulty whatever about it. In the first half of the first year the men are all taken together, and there is very little difficulty about it; they are purely lectures. In the second half of the first year they are divided up into half classes, and that means really doubling the teacher's work, because it means that each lecture has to be given twice over. In the same way with the engineering designs, which mean examples and so on, there again there are half classes all through that part of the second year, whilst in the mechanical laboratory you go down a stage further, and you have a quarter of a class. No one man therefore could do the whole thing in this way and instruct the quarter classes; what I do say is that as far as the subjects go Dr. Brightmore is perfectly capable of teaching them all. He is capable of teaching applied mechanics; he is capable of teaching hydraulics; he is capable of teaching machine construction; he is capable of teaching engineering, and what up to date has been called descriptive engineering—practical engineering, if you like—he is quite capable of teaching all that; but he has not got the time for it, so there must be somebody to help him. I suggested Mr. Woods. I kept Mr. Woods in mind especially, because he also is able to deal with the practical as well as the mathematical part of the subject. I have no doubt whatever that the number of hours I named may be taken as

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approximately correct. By re-arrangement it can be varied to a certain extent, but the figure given is not far out.

721. This matter has been a good deal remarked about, whether the staff under the new arrangement is sufficiently numerous to insure the very best results. Professor Hearson gave his own reasons at some considerable length for thinking that the staff would not be numerous enough, and I think that we should direct your special attention to the question, because it is one of the most important that we have to deal with; so I should like to go on with what Professor Hearson said. He said he thought that Colonel Ottley very much underrated the importance of the subject, and did not satisfy at all the teaching of that subject in order to balance it with the rest of the teaching. He then told us that he drew out a scale of what he makes out would be necessary to fulfil the arrangements foreshadowed in your report, and eventually I put this question to him. "How many lectures a "day have you got down for Dr. Brightmore—the most?—(*A.*) Four. "I cannot make more than four, because there are not more than "four divisions. (*Q.*) Four lectures a day?—(*A.*) Yes." Then he was asked by the Chairman whether he had shown his timetable to Colonel Ottley, in order to see that it is correct, and he says, "I have not shown it to Colonel Ottley." Then I said to him "Perhaps you had better put it in," and it was put in. One of the points I am very anxious to get at is, whether these suggestions of Professor Hearson represent what Dr. Brightmore will really have to do; will he have to lecture four times a day?—*A.* You will understand that I propose that certain branches should be taken up by the assistant, and others taken up by Dr. Brightmore. Roughly, what I propose is, that the work should be divided approximately as follows: that Dr. Brightmore should take machine construction, hydraulics, pneumatics, water supply, river engineering, and sea works as his subjects; that Mr. Woods should take the strength of materials, roads, bridge construction, sewage works, and railways; and that I should take canals and irrigation. Taking the timetable, which you had before you and which is published in the Blue Book, for the first half of the session, on the Monday Mr. Woods would be one hour lecturing, 1½ hours in the mechanical laboratory, and one hour on examples and designs; that is 3½ hours. On the Monday Dr. Brightmore would be, according to this timetable, two hours lecturing, and 3½ hours on examples and designs. On the Tuesday Mr. Woods would have no lecture, but he would have 1½ hours in the mechanical laboratory, and one hour on design; and Dr. Brightmore on that day would have three hours lecturing and 2½ hours on designs. On Wednesday Mr. Woods would have two hours lecturing and nothing else, and Dr. Brightmore would have no lecturing, but he would have 1½ hours on design. On Thursday Mr. Woods would have no lecture, but he would have 1½ hours in the mechanical laboratory and one hour on design; and Dr. Brightmore on the same day would have three hours lecturing and 1½ hours on design. On Friday Mr. Woods would have no lecture, but he would have 1½ hours in the mechanical laboratory, and one hour on design, and Dr. Brightmore would have two hours lecturing and 2½ hours on designs. On Saturday, Mr. Woods would have one hour lecturing and nothing else, and Dr. Brightmore would have one hour on designs. The total hours per week would be, for Mr. Woods four hours on lectures, six hours in the laboratory, and four hours on design, a total of 14 hours on the whole week. Dr. Brightmore would be 10 hours on lectures and 12½ hours on designs, that is 22½ hours. For the second half of the session, taking again Monday, Tuesday, Wednesday, Thursday, Friday, and Saturday, Mr. Woods would be eight hours lecturing, 12 hours in the mechanical laboratory, and 7 hours on designs, and Dr. Brightmore would be nine hours on lectures and five hours on design; that is to say Mr. Woods would have 27½ hours in the week, and Dr. Brightmore would have 14 hours. As to this, I have said, it would probably be possible to rearrange the hours hereafter so as to equalise them better in the two halves of the session, so as to give Dr. Brightmore and Mr. Woods about 18 hours each in the first half, instead of 22 and 14 respectively, and 20 hours each in the second half instead of 14 and 27 respectively. It must be borne in mind that the work in the mechanical laboratory, which is 6 hours per week in the one half and 12 hours in the other half of the year, and in supervising examples and designs, which is similarly 16½ and 18, is not of the same

exhausting nature as the lecture proper, which occupies 15 hours per week in one half and 17 hours in the next half. The greatest amount of lecturing for any one man is three hours in one day, and it is possible to re-arrange this so that no man shall have more than two hours lecturing on any one day. *Col. Ottley.*

722. Then Professor Hearson is quite mistaken in saying that Dr. Brightmore has got to lecture four hours a day?—*A.* As it stands at the present moment, he has only got three, and I think it can be so arranged that he shall only have two; and they generally have a day off as well so far as lectures are concerned.

723. Therefore, broadly speaking, having given the whole subject your careful consideration in consultation with Dr. Brightmore—— *A.* And Mr. Woods—.

724. May we take it that you see no difficulty in carrying out the time-table as settled, and giving that tutorial instruction, as well to which you drew pointed attention?—*A.* That is so.

725. Now a question about college boards. It has been represented to some of us that Cooper's Hill is somewhat exceptional in the infrequency of the staff meeting together in college board for the discussion of matters connected with administration and teaching. Can you tell us what is the practice at Cooper's Hill, and what is the intended practice in the future?—*A.* The past practice, during the latter part of Sir Alexander Taylor's time, was that they met about once a year, and sometimes, I think, at greater intervals than that.

726. What was the practice with Colonel Pennycuick?—*A.* Colonel Pennycuick laid down the principle that they should meet once a month, and I commenced on that principle, and worked at it for some months, I think for five or six months, but I found there were no entries made in the agenda book and nobody had anything to bring forward, and, frankly, I found it was a waste of time. So instead of summoning the college board, when any question arose on which I thought the opinions of the staff were desirable, I circulated it by notice to everybody, asking them to say what they had to say. I found that college boards were by no means satisfactory. There are three kinds of college meetings. There is the annual meeting, which has to deal with marks; that has always been held and must always be held. Then there is the emergent meeting, which has been very largely held to deal with discipline, and in that case I think it is generally out of place. I think there should be one man in charge of the discipline, namely, the President. I do not think it is a good thing for the President to shelter himself behind others. However, in this matter I do not mind what decision is come to. The ordinary monthly meetings, as I say, I held them as long as there was any work in the agenda book to be done, and subsequent to that I circulated notices. I am not very much in favour of these fixed montly meetings. I find that what my colleagues, or some of them, were really striving at was to have a Senate. In short they are playing at being a university, whilst Cooper's Hill is nothing of the sort; it is a technical school, and not a university at all. A number of the staff are university men, and they would like evidently to turn the place into a university. You can see from what they have been saying in the papers that they want a Senate, which I think is somewhat out of place. I do not know what the customs are elsewhere, but at Sandhurst and Woolwich the customs are, I believe, that the President or the Governor, or the Commandant, discusses the studies with the professor or professors in charge of the particular study he is dealing with, and I think there, practically, consultation ends. I do not think there is more than that done. I think anybody who wishes to know what they have done in the past at Cooper's Hill has only got to read the minutes of the proceedings of the Board, and I think that they would satisfy themselves that the meetings were ordinarily a great waste of time.

727. I only asked the question, because I have heard the matter criticised. One witness, I forget his name, said that you had forbidden anything to be put down on the agenda paper for the college board?—*A.* It is easy to make such statements. The history of that is this. In the agenda book, which is, I understand, on the table, amongst other notices put down was one by Mr. Fisher, that the wearing of gowns by students should be abolished. When the agenda book was brought up to me, I sent for Mr. Fisher, and

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explained to him that this question of abolishing gowns was not one for the College Board to discuss; that it was a matter which appeared in the prospectus which had been passed by the Secretary of State in Council, and consequently was not within our competence to discuss. I added that, as a matter of fact, since so many had spoken to me on the subject, I had written up for permission to abolish gowns and, therefore, I thought it would be as well that this particular proposition should be ruled out. He agreed, and I ran my pen through it. That is the only foundaion there is for that statement. It was remarked lately in the daily press that I only erased anything important, and that anything trivial I allowed to come before the Board; the one thing I did erase was the proposal to abolish students' gowns.

728. *Chairman.*—And that was referred to the Secretary of State, was it not?—*A.* That had been previously referred to the Secretary of State, and being a matter to be decided by the Secretary of State in Council, it did not seem to me to be a matter for the College Board. This question applied to the students, and, of course it did not touch the professors. Sometime afterwards the professors asked me whether the order abolishing gowns also applied to them, and I think you have before you a paper which I circulated to the staff, in which I said that it was open to any professor to wear any gown he thought fit. One of my reasons for personally objecting to a gown was that I found I had to wear the gown of a Master of Arts of Oxford, and as I am not a Master of Arts of Oxford, I did not see why I should masquerade about in a uniform which did not belong to me. As long as it was an order, I said I would carry it out, but I asked the Secretary of State to kindly absolve me, which he did.

729. *Sir Alexander Rendel.*—Mr. Reilly only gave a very moderate proportion of his time to the College; had he any other occupation or means of making an income, so far as you know?—*A.* Not that I know of.

730. Or Mr. Heath?—*A.* None that I know of.

731. Is every tutor supposed to give his whole time to the College?—*A.* Yes, they are supposed to do that, except that they take examinations outside, and so on.

732. But they are not supposed to carry on another occupation?—*A.* No.

The witness withdrew.

Dr. A. W. BRIGHTMORE called and examined.

Dr. Brightmore.

733. *Chairman.*—When did you come to the College?—*A.* I came at the beginning of last session, in September 1899.

734. As Professor of Engineering?—*A.* As Professor of Engineering Construction and Surveying.

735. How did you find the instruction staff in your department arranged when you came; and how were the subjects divided. Will you tell us exactly how the thing stood?—*A.* When I came Mr. Woods was taking the classes in surveying, and Mr. Heath what was called descriptive engineering. I took the subjects Professor Reilly had taught.

736. What was Professor Hearson doing?—*A.* Professor Hearson was lecturing on hydraulic engineering and mechanism.

737. I want to know how it was arranged when you came, and what happened after your arrival?—*A.* I was describing what happened after my arrival. Mr. Woods was taking the survey, Mr. Heath descriptive engineering, and I took up what Professor Reilly had done when he was at the College—that was the strength of materials and design of structures. Professor Hearson, as I have said, was responsible for hydraulic engineering and mechanism.

738. You did not consider that you had that part of the subject under you?—*A.* No; I understood that was quite distinct.

739. You thought it was quite distinct, and that you had no responsibility for it?—*A.* That is so.

740. Do you understand the new proposals that Colonel Ottley has made?—*A.* Yes; I have seen all the details of them.

741. Will you explain what those proposals are?—*A.* The proposal, as I understand it, is that the subject of engineering should be placed under a single professor, instead of under three professors as it is at present; that is to say, instead of there being a professor of constructive engineering, a

professor of hydraulics and mechanism, and a professor of descriptive engineering—that a single man should be responsible for the whole subject of engineering and should have an assistant to help him in the work. *Dr. Brightmore.*

742. Have you consented to that arrangement? Has Colonel Ottley consulted you upon it?—*A.* Yes he has. The arrangement seems to me to be very advantageous from the point of view that, as it is at present, it is very difficult for any of the three professors to make any advances or changes in their particular department, because the subjects naturally overlap, and by doing so, he would interfere with the other two and probably cause friction. By the subject being placed under a single man, he would have a free hand; at least he would not have to consult two colleagues, and would be able to develop the subject and keep it up to date with much less inconvenience.

743. Are you prepared to undertake that with the assistance of another man?—*A.* Yes, I am quite prepared to do so.

744. You have fully satisfied yourself that you can do it; that it is not too much for your powers?—*A.* I feel quite confident that there is no particular difficulty in doing so. I have considered what it means. It apparently amounts to this—two lectures a day, that is to say, for both myself and my assistant, and about three hours instruction in class or in the laboratory. I do not think that would overtax one's strength.

745. How much does that amount to per day?—*A.* It is about five hours each day.

746. How many hours have you been accustomed to work in the day?—*A.* I have been accustomed to work more like eight hours. Of course that does not include any time necessary for preparing the lectures; but that is a gradually diminishing quantity.

747. You see no difficulty in carrying this out?—*A.* I see none whatever.

748. *Mr. Leonard.*—With one assistant?—*A.* Yes. Of course that does not include surveying.

749. *Chairman.*—The surveying would be quite separate?—*A.* Yes.

750. But still you would be responsible for the surveying, would you not?—*A.* That would be as it was arranged. I am not clear whether it is intended that I should be responsible for the surveying or not. I do not think, however, that is material.

751. It would not overlap or interfere with the subjects in the way the others might?—*A.* No, it would not interfere.

752. When you came to the College, were you received cordially and in a friendly manner by the other teachers and professors?—*A.* At first I was outwardly so, but I very soon found that the conditions of my appointment were rather impossible in this way;—Mr. Heath, who was one of my assistants, refused to recognise the position, and I am not quite sure that he does so yet, at all events for a long time he declined to recognise it, and it was only when pressure was brought to bear upon him by Colonel Ottley that he took my instructions. In that way I have found that it was extremely difficult to work the subjects as I should like to have done.

753. Did you find the behaviour of the students in class was proper and quiet?—*A.* Not as quiet as I should have liked it to have been, certainly. When first I went to the College my work was made particularly difficult from the fact that Colonel Pennycuick, the late President, wrote a letter to "Engineering," in which he stated that he was resigning because a man of insufficient experience had been appointed to the professorship, which I occupied. This letter was copied in the College Magazine, which is read by all the students, and naturally, having the authority of the President that I was an incompetent man, it was not likely that the students would be as attentive as one would have liked them to have been.

754. Was that done before Colonel Pennycuick left the College work?—*A.* Yes, he was there for a few days after I came.

755. Was the letter published in the College Magazine while Colonel Pennycuick was the ostensible head of the College, do you know?—*A.* I believe the magazine was not actually published while he was at the College.

756. But the letter in "Engineering" was published while he was still President?—*A.* Yes.

Dr. Brightmore.

757. Who is the editor of the College Magazine, do you know?—*A.* I believe Mr. Hicks is the editor of the magazine.

758. One of the teachers in the College?—*A.* Yes, he is instructor in geometrical drawing and estimating.

759. That must have made it difficult for you?—*A.* That, of course, made it difficult. There were other members of the staff who, I think, were quite as inconsiderate in the way they expressed their opinions to the students.

760. To the students?—*A.* Of course I have only indirect evidence of this, so I cannot speak to it.

761. *Sir William Bisset.*—How did you get your appointment to Cooper's Hill College?—*A.* I saw the appointment advertised.

762. You applied in response to an advertisement?—*A.* Yes.

763. You were able to show your previous experience?—*A.* Yes. One of the chief points I relied upon in making my application was my experience for 13 years in responsible positions in carrying out works under Mr. Deacon and Mr. Mansergh, and, of course, I had my college training previously to that.

764. *Sir William Preece.*—Where was that?—At Owens College, Manchester.

765. *Sir William Bisset.*—You also have written works on the subject, I believe?—*A.* I have written in conjunction with Dr. Tudsbery a work on the Principles of Waterworks Engineering.

766. And you saw the Committee who were appointed to select the Professor?—*A.* Yes, I appeared before the Committee along with three other candidates.

767. *Sir Courtenay Ilbert.*—Colonel Ottley mentioned that he proposed to lecture on one branch of engineering?—*A.* Yes, that is irrigation.

768. With that assistance, I suppose you have no doubt whatever that the staff would be ample to teach engineering?—*A.* No, I am quite confident that it could be done without any great strain on the staff.

769. *Chairman.*—Even if he did not give that assistance?—*A.* Even if he did not give that assistance it would still be possible to do the work.

770. You say it would still be possible, but would it be on the verge of an impossibility?—*A.* No, I think it would be possible to do it with comfort.

771. *Sir Alexander Rendel.*—I suppose your connection with the College began with a little aversion?—*A.* Yes, I have not seen it under the best circumstances, so far.

772. *Sir Courtenay Ilbert.*—I understand from what you have said that you consider the distribution of work in the engineering department, as it existed at the time you came, inconvenient from a teaching point of view?—*A.* Yes.

773. On what grounds?—*A.* On the grounds that being taught by three practically independent professors, as the subjects naturally overlap, it was difficult for each individual professor to carry on the work to the best advantage. I may give, as an example of that, that I taught, for instance, the theory of strength of materials, whereas the laboratory work was under Professor Hearson; so that it was impossible to combine the instruction in the laboratory with the lectures. As a matter of fact, in order to fit in my course, I had to take strength of materials for the second-year men, and they did not have any laboratory work until the third year.

774. Was any proposal made to you by Professor Hearson as to an interchange of work?—*A.* Yes. When I came to the College he suggested that such a thing might be desirable; I spoke to him several times afterwards about it, but he did not seem to have quite made up his mind whether it would be the best thing to do. He never made a definite proposal, that is to say, he never actually decided which part of his subject he would be willing to exchange for any particular part of mine. However, he did mention that it might be desirable to make an exchange in the work.

775. Was any definite proposal for a change submitted to Colonel Ottley for sanction?—*A.* No. I mentioned the matter to Colonel Ottley. As far as I know, Professor Hearson never did. But no scheme was ever submitted. I simply suggested it to him as a better combination of the work than the present combination.

776. Did you submit a specific proposal to Colonel Ottley for sanction?—*A.* No, I simply made a suggestion to him to that effect. I had no authority from Professor Hearson to submit any definite proposal.

777. Did you ever press Colonel Ottley to allow the exchange?—*A.* No, I did not press the matter. I thought that unless Professor Hearson was equally anxious for it, it was useless for me to press the matter; and as he did not take the matter up, I did not go on with it.

778. Have you any acquaintance with the course of teaching in any other engineering colleges?—*A.* My chief acquaintance is with the teaching at Owens College in Manchester, where I went through the engineering course. With regard to other colleges in the country, I have exmained the respective courses of studies as given in their calendars, so as to see what subjects they teach; and in drawing up a report which Colonel Ottley asked me to do, on what I considered the best course of study for an engineering college, I compared the course of studies in all the principal engineering colleges in this country.

779. Are you in a position to make a comparison between the course of instruction as given at Cooper's Hill when you came, and the course of instruction at other engineering colleges, either as to the amount of time bestowed by the teachers, or as to the distribution of the work—or, perhaps that is too general a question to put to you?—*A.* I think, generally speaking, the amount of time at Cooper's Hill was less than at other colleges I am acquainted with.

780. The amount of time given by the teachers, do you mean?—*Q.* Yes.

781. *Chairman.*—Did you say much less?—*A.* As I say I cannot speak definitely, except as to Owens College. It was certainly less than the amount of work done by the professors there during my time.

782. *Sir Alexander Rendel.*—What do you think is done in the private study hours? Do many of them do much then?—*A.* My impression is that very little is done by the majority of the students then.

783. You have been asked a question as to the manner of your appointment here. I think I am right in saying that you were holding a very excellent position, and that you gave it up simply because you liked teaching?—*A.* Yes. I was Resident Engineer on 20 miles of the Birmingham Water Works for Mr. Mansergh.

784. *Sir John Wolfe Barry.*—Are we right in considering that your view is that it is for the good of the College there should be one professor of engineering, who would more or less control the various branches of tuition?—*A.* Yes. I think that would be for the good of the College; I should say that even——

785. Even if you were not the gentleman in question?—*A.* Yes.

786. As a matter of principle you would say that it was to the advantage of the College that it should have one professor of engineering, who would be responsible for the whole teaching of engineering, with the requisite number of Assistants, whatever it might be, more or less, under him?—*A.* Yes.

787. Rather than having concurrent teaching going on by professors, who are more or less independent of each other?—*A.* Yes, that is my view of the matter.

788. You think it would be distinctly good for the College and for the students?—*A.* Yes.

789. And for the reputation of the College?—*A.* I think so.

790. Do you find now that you are able to manage the students better than you were before?—*A.* Before the late incidents, that is, before the question of the dismissals, I found the students getting a little more manageable, but since then there has been a considerable retrogade step. Since that time I have found that there seems to have been an organisation amongst the students,—of which I have had evidence in several incidents which I need not mention,—to cause interruptions in a way that is very difficult to detect,—in fact, to make disturbances when my back has been turned or my attention distracted in any way, so that it was almost impossible to pick out the offender. Since the incidents above mentioned have arisen, there has been a retrogade step in the conduct of the students, but I think that is only

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temporary, and I believe when the disturbing causes are removed, that will be at an end.

791. During the state of transition, things are not very happily situated ?—*A.* No, the students naturally, I think, sympathise with the professors they have known since they have been at College. I suppose they think that by causing me inconvenience they are furthering the interests of these professors. That is the only conclusion I have been able to able to arrive at.

792. You do not anticipate in the future any particular difficulty when the question for good or bad has been settled ?—*A.* No, I think when the question has been settled there will not be any further difficulty.

793. It is very undesirable to keep this an open question longer than can possibly be helped ?—*A.* Yes.

794. To that extent, I suppose, assuming the changes had to be made, it is not desirable to keep these changes hanging over the head of the College for longer than is absolutely necessary ?—*A.* No; I think during the time of the change it is bound to exert a disturbing influence on the students, which I suppose is only natural.

795. Therefore, if there had been two terms' notice, instead of one term's notice, it would have been so much worse ?—*A.* Yes, I think it would have been worse for the students.

796. *Sir Alexander Rendel.*—Which behave the worst, the third-year students, or the second-year students, or the first year students ?—*A.* The third-year students.

797. The third-year students go next July, do they not ?—*A.* Yes.

The witness withdrew.

Mr. R. J. Woods called and examined.

Mr. R. J. Woods.

798. *Chairman.*—Will you tell us your position in the College ?—*A.* I am at present Instructor in Surveying.

799. I believe you have been in the College some time ?—*A.* Yes, about six years.

800. Are you acquainted with the alterations proposed to be made in the engineering branch ?—*A.* Yes, I am.

801. Have you seen the timetable which Colonel Ottley has drawn up ?—*A.* Yes, I went through the Engineering branch of that timetable with him a few days ago.

802. Are you satisfied that Dr. Brightmore, with your assistance, will be able to give the teaching that is requisite ?—*A.* Yes, I am quite satisfied on that point. It works out to about 20 hours per week each, that is a little more than three hours a day.

803. Do you think that you are able to work for three hours a day ?—*A.* Yes, I think so, at present.

804. You do not feel over-burdened ?—*A.* No, I do not think three hours or four hours a day is too much to ask.

805. Does that three hours a day include the laboratory as well as the lecturing ?—*A.* Yes, according to the timetable.

806. There is teaching in the laboratory ?—*A.* Yes.

807. Of course you might have to spend time in preparing lectures, apart from that ?—*A.* Yes.

808. But for actual teaching there would be three hours a day ?—*A.* Yes. I know from experience the first year,—when you have to prepare the lectures, —would be the most severe year; the work, of course, is heavier the first year, but after that it is chiefly revising and keeping yourself up to date. The actual work comes to about 20 hours a week, and I do not think that is too much for a man.

809. For each of you ?—*A.* Yes, for each of us.

810. Professor Hearson expressed an opinion that no man could do it, but you do not agree with that ?—*A.* I do not think 20 hours a week too much.

811. *Sir William Bisset.*—You have had some practical experience in surveying, I think ?—*A.* Yes, I have done a good deal.

812. You conducted a large railway survey, if I remember rightly, in Burma ?—*A.* Yes; my first experience on survey work was in the Khojak

Pass. I was out there for about two years under Sir James Browne, when I first found the preliminary line and afterwards laid it out. Subsequently, from there I went and surveyed the railway from Quetta to Kach behind the Tukatoo Range. Then I went to Burmah, and I made a reconnaissance for a railway from Minbu to Chittagong over the Aeng Pass. *Mr. R. J. Wood.*

813. You got a distinction at Cooper's Hill, I think?—*A.* Yes, when I was at College I got a fellowship there.

814. *Sir William Preece.*—I suppose you will agree with what we have already heard from previous witnesses, that there is not an absolute definiteness in the responsibility allotted to the different engineering professors in Cooper's Hill at present, that their duties are not strictly defined, and that there is overlapping?—*A.* Yes, there may be and probably is overlapping, and it is possible for different professors to be teaching the same branches of the subject.

815. Therefore there would be a great advantage in concentrating the responsibility of a department in one man?—*A.* Yes, in one man who would be responsible for it all.

The witness withdrew.

Adjourned to Thursday next at 3 o'clock.

LIBRARY OF THE BOMBAY BRANCH OF THE ROYAL ASIATIC SOCIETY

MINUTES OF EVIDENCE

TAKEN BEFORE THE

BOARD OF VISITORS AT THE INDIA OFFICE,

ON

Thursday, 21st March 1901,

IN REFERENCE TO THE

Remodelling of the Studies and the Retirement of certain of the Professors and Lecturers.

THIRD DAY.

Present:

SIR CHARLES H. T. CROSTHWAITE, K.C.S.I., Chairman.
SIR JOHN WOLFE BARRY, K.C.B., F.R.S.
MR. HUGH LEONARD, F.S.A.
MR. JAMES MANSERGH.
SIR W. H. PREECE, K.C.B., F.R.S.
SIR W. S. S. BISSET, K.C.I.E., R.E.
SIR ALEXANDER M. RENDEL, K.C.I.E.
SIR COURTENAY P. ILBERT, K.C.S.I.

Professor GEORGE MINCHIN MINCHIN called and examined.

Prof. Minchin.

816. *Chairman.*—What is your appointment at Cooper's Hill?—*A.* I am Professor of Applied Mathematics there.

817. Are you acquainted with the alterations in the curriculum which are proposed, I mean so far as they affect your department of teaching?—*A.* Yes, certainly.

818. Have you any observations to make with regard to their effect upon your department?—*A.* Yes, I think I have a great number of observations to make. In the first place, the account that is given in the Blue Book, on page 26, of the method of teaching mathematics is entirely erroneous; it does not present the actual state of affairs as regards the mathematical teaching at all. It leaves the reader, and I have no doubt it leaves you, under the impression that the teaching of mathematics is wholly by what it calls the lecturing system. You will see that it says:—"The last great "objection to the present method of teaching mathematics at the College "appears to be that, owing to the size of the classes, the professors "have had to adopt the 'lecture,' as opposed to the 'tutorial,' system." I am sorry that there are not some of the other objections mentioned; I cannot see what the other objections referred to are, but that is a very

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serious one—that the method of teaching is the lecturing one wholly. Of course a method of teaching mathematics or any scientific subject wholly by lecturing must be a failure, undoubtedly. But the method at Cooper's Hill is nothing of the sort. It is a very careful combination of the lecture and the tutorial system. In every lecture which I deliver in mathematics, and in every one that I have delivered since 1875, there has been a general exposition of the subject whenever a new branch of it cropped up, explaining the nature and aims and so on, and sometimes the history, to the whole of the class. It has been then illustrated by me on the blackboard by worked-out examples. That has, in turn, been followed up by individual work set to the members of the class; and then I have gone round from one to another, to see how this work was being done. So that there is really a very large mixture of what is called the tutorial or individual system in all the mathematical lectures. Then there is another point about it, to which I wish to call your very particular attention. Near the end of the last paragraph on page 26 it is said "It is unquestionable that this latter "—that is to say, the tutorial system—" was the system approved of by the late Sir George Chesney." On the contrary, I am sorry to say, the representation is very much what it ought not to be there. The tutorial system is exactly the one which was condemned and rejected by Sir George Chesney.

819. The tutorial system?—*A.* Yes. When I came to the College, there was nothing but the tutorial system; there was no lecturing, and no general exposition of any subject at all to the students. The thing worked out in this way, that a few of the students, perhaps four or five of them, came up to the professor's desk, and there they stood for most of the time, and a great number of the others never got a chance at all. That was the way it often worked out. I myself had been lectured in mathematics by such men, for instance, as Salmon and Jellett, and I knew that lecturing in mathematics was perfectly possible; so I introduced a combination of the lecture and the tutorial system. Sir George Chesney came at least 20 times to my lectures; he used to sit down amongst the students for two hours at a time, and so he made himself thoroughly acquainted with the system. His praise of it was very high. He expressed the highest admiration of this system, and he inculcated it upon everybody in the place. The way in which he particularly showed his approval of it was this; that he turned over the teaching of the whole of the applied mathematics in the College to me. Before that, I took applied mathematics and pure mathematics with a certain half of the College, and my colleague took the same things, applied mathematics and pure mathematics, with the other half, so that I had nothing whatever to say to one half of the College for about two years, and my colleague had nothing whatever to say to my half. Sir George Chesney determined to put an end to this, and he turned over the whole teaching of one of the subjects, namely, applied mathematics, to me. He very greatly approved of that, and he never lost an opportunity of praising the system afterwards. I think that it is well that you should know, therefore, that that statement in the Blue Book is not a correct presentation of the state of affairs. The very end of the last paragraph on the page, again, makes an assertion to which I must demur: "This is the "principle that I now wish to revert to, after having seen the failures due "to a departure therefrom" It is to those words that I object. I do not admit that any failures that have occurred in mathematics are due to that. The failures that have occurred in mathematics are really very small in number after all. I have the numbers here, reaching back for several years. They oscillate; they are sometimes two, sometimes three, sometimes five; in one year they ran up to the abnormal number of 11. It was three years ago when they went up to 11, and then they dropped back to four, and last year the number was two.

820. That would be 11 out of how many?—*A.* It might be perhaps 11 out of 40—somewhere about that.

821. And the two would be out of how many?—*A.* The two would be out of about the same number.

822. *Sir Alexander Rendel.*—Are you speaking of third-year men?—*A.* No, I am speaking of the second-year men. We have nothing whatever to say to

the third-year men in mathematics at present. By the way, lest I forget it, I may say that in one respect I strongly approve of Colonel Ottley's proposal about mathematics; that is to say the proposal to run mathematics into the third year. As regards my mathematics, applied mathematics, I think that that is a necessary thing to do, especially in view of the electrical engineering which is to be a part of the course. *Prof. Minchin.*

823. *Chairman.*—Hitherto have mathematics dropped with the second year?—*A.* Always.

824. Altogether?—*A.* I have had some mathematics with the third-year students; I have had mathematical physics in connection with electrical questions, and mathematical theory in connection with electricity and magnetism, alternating currents, and things of that sort.

825. But as a rule it has dropped with the second year?—*A.* Yes, broadly speaking.

826. You approve of extending it to the third year?—*A.* I approve of extending applied mathematics, but my colleague, Professor Lodge, does not want his mathematics extended to the third year.

827. Perhaps we had better not mix up the two branches, except so far as really pertinent to your course.—*A.* I think it is a little pertinent if I might mention Professor Lodge's objection to run pure mathematics into the third year.

828. If it is necessary do it, but, as we are going to hear Professor Lodge, we shall therefore be hearing the same thing twice over; that is the only objection I have to your going into it. If, however, you feel it necessary, in order to elucidate your own remarks, please deal with it.—*A.* I think that if a little mathematics, enough to keep up their second-year knowledge, is run into their third year, it will be good, but I do not like interfering with the special designing work and the special engineering work of the senior students, and therefore, while I approve of taking the applied mathematics in, I think that there is a danger of doing too much of it.

829. You are not so sure about the pure mathematics?—*A.* No. I rather agree with Professor Lodge on that point.

830. So far as Colonel Ottley advocates the tutorial teaching, in preference to mere lecturing, you do not disagree with him, but you hold that tutorial teaching has been going on, and you consider that the teaching of mathematics should be by a mixed system of lecturing and tutorial teaching?—*A.* Undoubtedly.

831. Colonel Ottley is mistaken in thinking that the present system is one of mere lecturing?—*A.* Yes, much mistaken.

832. But so far as he advocates the tutorial method you are at one with him?—*A.* Provided it is combined with the lecturing.

833. Then there is the question of extending applied mathematics to the third year; in that you agree with him?—*A.* I agree.

834. Another point that he took was, stiffening up the entrance examination in mathematics. I suppose you do not differ from him on that?—*A.* I have been talking to presidents for several years past about that.

835. Do you wish to have it done?—*A.* Yes, I wish to have it done; but I have warned them all, when they have been very anxious to do it. No one was more anxious to do it than Colonel Pennycuick, and when he proposed to do it straight off, he, I think fortunately, mentioned the matter to me, and I said, "I should, of course, welcome such a thing as a very great "improvement; for one thing, it will make my work in the College "very much easier than it is, for I shall then have to deal with fairly "qualified men, instead of having to deal with a large number of very "weak men; but," I said, "I would advise you strongly to put the matter "before the India Office, because it is mixed up with the financial question "of filling the College."

836. But if we want to fill the College with men who are properly qualified for being made into engineers, we must raise this entrance examination, must we not?—*A.* Yes.

837. If we merely look upon it as a financial matter, we might take them in without any entrance examination at all?—*A.* Of course, that would be an immorality.

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838. But it would be an immorality only less in degree, if you let them in on an easy examination?—*A.* Yes. It would not practically affect the men who get into the Indian service. They have not been in the least affected by the taking of the entrance examination out of the hands of the Civil Service Commissioners, and by its being made a mere qualifying examination of the rather low class, which it is at present.

839. Why not?—*A.* Because there are only perhaps 12 or 15 men who can get into the Indian Government appointments, and those men are well prepared. They say to themselves, before they come in "We mean to get "into the appointments, and we do not mind about this qualifying entrance "examination and schoolboy work." They come in with a considerable surplus knowledge, of such things as the calculus, and mechanics, and so on. So that I do not think there is any appreciable difference, at any rate I have not noticed any difference in the 26 years I have been there, in the quality of the men who go into the Indian Engineering service.

840. *Sir Alexander Rendel.*—Not in the quality of the best men, do you mean?—*A.* No; in the quality of the whole of the men who go into the Indian service.

841. Speaking of the men at Cooper's Hill, do you notice any difference in the quality of the best men who enter there?—*A.* No.

842. Do you notice a difference in the quality of the worst men?—*A.* There is a slightly larger, an appreciably larger, tail of bad men entering, of course, under this system, than under the old one; but remember that, under the old system, it was possible to have a bad tail too, because when the examination was held by the Civil Service Commissioners, it included classical subjects, and I had some of the worst men whom I have ever had under me, at the very beginning of my career there in 1875—men who came under the Civil Service Examination, simply because they got in on Greek and Latin. They were very nearly as bad as some of the worst men now.

843. *Chairman.*—The Board of Visitors recommended that two instructors should be appointed to assist the mathematical professors, with the main object of increasing the possibility of tutorial instruction; do you object to that, and do you think it is necessary or unnecessary?—*A.* I do not think that it is necessary. I think that the true solution of that is to revert to what was the universal custom in the earlier days in the College, that is, to have no whole-year lectures in mathematics; but to have lectures all divisional, that is, to take half the men at a time. We had more lectures in that way; but, instead of having to deal with perhaps 38 or 40 men at a time, we had only about half the number.

844. I understood from Colonel Ottley's remarks, that Sir George Chesney broke the classes up into classes of about 25 each?—*A.* Yes, about that.

845. Do you mean that things have gone back now from that to bigger classes?—*A.* They have, and necessarily.

846. Will you explain that?—*A.* Yes; that is a very important point. Up to 1887 there were evening lectures in mathematics. Those evening lectures were really a farce, because my time used to be spent very largely in keeping the men awake. It was after dinner. They dropped off to sleep, and I was sometimes rather sleepy myself. At any rate there was very little work done; and the result was not worth the amount of trouble taken. Sir George Chesney saw that, so in 1877 he abolished evening work in mathematics, but geology and physics remained on for some years as evening subjects. After a while those came down, in, I forget the year, to morning lectures. In that way they competed for time with those subjects, like mathematics, which were taken in the morning; and in that way we lost time; so we had to take a whole year, instead of the two halves of the year separately.

847. That implied larger classes?—*A.* Yes, it did; but, even after that the whole-year lectures were the exception, and there were always divisional lectures for a long time. Then another thing happened in 1884. The physical laboratory was instituted. Physics branched off from chemistry, and we came to the conclusion that it was time to march along in the physical direction; physics was becoming a very important subject, and we had not made any proper arrangements for it. Then I represented to Sir Alexander Taylor that he should take the opinion of Sir William Siemens,

and Sir William Thomson, as he then was (Lord Kelvin) on this question of the desirability of founding a physical laboratory. That was founded. Of course, the physical laboratory took up a very great deal of time, and that also competed, so that the mathematical time then got further cut down, and it was lumped up into whole-year lectures instead of divisional ones. Before last summer, I begged of Colonel Ottley to give me more divisional lectures, especially with the second-year, and he promised to do so. I am sorry to say that he forgot his promise, and all the lectures are now whole-year lectures. *Prof. Minchin*

848. Have they been so for some time?—*A.* No, not all.

849. Now I want to get from you the number of men in each class at each lecture.—*A.* At present I have about 32 in every second-year lecture, 38 in every first-year lecture. I have got the whole of the second-year at a time, and the whole of the first-year.

850. How long have the classes been of that size?—*A.* They have been of that size since Colonel Ottley came. I do not think that they had been invariably of that size before.

851. Before, were they smaller?—*A.* Yes. They were smaller occasionally. Occasionally I had to take the whole year, but, as a rule, until within the last couple of years, I have always had these divisional lectures, with only half the men, 20 or 19 men at a time.

852. That is during the last couple of years you have had these big classes?—*A.* Yes, about that time.

853. How long has Colonel Ottley been there?—*A.* About a year and eight months, I should think.

854. Did these big classes begin before his time, or did he introduce them?—*A.* I think they have been exclusively big classes, as well as I remember—I cannot be positive about that, but they have been exclusively of the large sort—since he came.

855. And before that?—*A.* There were always some halves before.

856. Some small ones?—*A.* Yes.

857. I do not know what his practice may have been, but what he advocates clearly is the smaller classes; you think that, too, do you not? You think they ought to be smaller classes?—*A.* I do not think that we understand quite what he means by smaller classes.

858. I understand what I mean; you say you are dealing with classes of 83 and 32. Is that too large a class for proper instruction in mathematics?—*A.* I think it is too large to be invariably dealt with.

859. And you would prefer to break them up into smaller classes?—*A.* Certainly. In connection with the breaking of them up into smaller classes, it is very important to note that one difficulty in the way of so breaking them up will be the proposed enormous increase in the time given to surveying.

860. I must ask you not to go into that or we shall never get to an end. Please say if you want to give more time to your mathematics or less time, and then leave us to see which is the better course. I was asking you about those two instructors, you will remember. Now it has come to this, that we say we ought to have smaller classes?—*A.* Yes.

861. Do you want those two instructors in order to have those smaller classes?—*A.* I do not want them at all.

862. You think you could have the smaller classes without?—*A.* I am perfectly prepared to deal with my smaller classes myself.

863. *Mr. Leonard.* By giving two lectures instead of one?—*A.* Yes.

864. *Chairman.* You do not want the instructors?—*A.* I do not want them.

865. As to having smaller classes, you consider that it would be a good thing, and, speaking for yourself, you wish it?—*A.* I am very strongly in favour of it. I wish we could go back to the original system when we had nothing but the smaller classes.

866. *Sir John Wolfe Barry.* What number do you call a small class?—*A.* A fairly manageable class would be from 20 to 25.

867. *Sir William Bisset.* So far as I see, although you take exception to his method of stating what the present practice is, you are practically at one with Colonel Ottley in regard to the method of teaching to be adopted for

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the future?—*A.* That depends upon whether Colonel Ottley wishes to impose upon the mathematical professor an inability to address his class as a whole. I am very strongly opposed to that.

868. I do not understand in what we have here before us that there is any prohibition of lecturing; it is merely that Colonel Ottley was under the impression, which you have tried to disabuse us of, that the lecture system was rather predominant; that is, that there was more lecturing than tutorial teaching.—*A.* I am afraid he has asserted or implied that there was nothing but lecturing.

869. I do not think so. I am expressing, I think, the opinion of the Board when I say that we never derived that impression until now when you have put it before us. Colonel Ottley has adopted a general way of stating it, and I never read it in the way that you have just stated it.—*A.* I thought that it was implied.

870. *Sir William Preece.* The last two sentences on page 26 of Colonel Ottley's report might almost have come out of your mouth. As I understand, you objected, in the first instance, to these words:—"It is unquestionable that this latter"—the tutorial system—"was the system approved of by the late Sir George Chesney"?—*A.* I entirely objected to that.

871. But you approve of this, do you not:—"In his first 'Regulations' he "laid down the rule that in mathematical and similar subjects the students "should be broken up into classes of about 25 each, whilst, on the other "hand, in the case of experimental science and some parts of the engi- "neering course, the 'Lectures' would be delivered to the whole class "collectively. This is the principle that I now wish to revert to, after "having seen the failures due to a departure therefrom"?—*A.* As I read those words, they imply that Sir George Chesney was opposed to the system of lecturing at all.

872. *Mr. Mansergh.* You told us that he was at first?—*A.* Yes.*

873. But after coming and hearing your lectures he changed his mind?—*A.* Yes, exactly.

874. Then Colonel Ottley speaks of changing back?—*A.* Yes.

875. So that he agrees with you?—*A.* If you look at Colonel Ottley's timetable you will find that there are no divisional lectures provided for at all.

876. We do not look at that timetable; that is merely a suggestion—a draft—and it is not before us. It would not be made permanent until Colonel Ottley consulted you on the matter; it is a mere tentative thing.—*A.* The reversion to the divisional lectures is precisely the thing we want.

877. That is precisely what he recommends and what you approve of?—*A.* Yes; but then you see if you revert to the divisional lectures, the half-year lectures—then your additional instructors in mathematics—become useless.

878. *Chairman.* With that of course we shall be so much the more pleased, but we do not wish any excuse to be made that there is not time on the part of the professors, and we would rather have two more instructors than have the work badly done; but, as I understand, you are perfectly prepared to do it without an instructor?—*A.* Yes, undoubtedly.

879. *Sir William Bisset.* According to Colonel Ottley's proposals, one of these two instructors, I suppose, would be attached to you?—*A.* I suppose so.

880. *Mr. Leonard.* Your plan seems to me to be the right one, namely, to give two lectures in preference to one.—*A.* I think so. There is a further reason for it, namely, that if you have homogeneity in teaching there is an enormous advantage. It makes a very great difference. Besides, I know from experience that it took me several years of work at Cooper's Hill before I settled down to a correct appreciation of the kind of mathematical work that those students want. It will take anybody else the same time. If you get some Cambridge man to come in, it will take him some years to get his ideas into order as to the kind of mathematics that our men want. They want a high class kind of mathematics which is applicable to engineering problems; and that is precisely the kind of thing

* I ought not to have said that Colonel Chesney was "opposed" to the lecturing system; I tried to make it plain that he did not "know" of it as possible in mathematics.—G. M. M.

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that the typical University mathematician is apt to overlook. May I be allowed to make a remark about the qualifying minimum on page 30 of the Blue Book? That is a very important thing. It is proposed to have a qualifying minimum of 50 per cent. in every branch, and therefore in mathematics and physics. I may tell you this with the utmost confidence, that I do not think any college in the world could exist on a qualifying minimum of 50 per cent. in mathematics or physics. The level of the teaching would have to come down to an extremely low one to get all the candidates up to a qualification of 50 per cent. Our present qualification is about the ordinary qualification in other institutions: it is 25 per cent. Of course it is very low, but then the qualification in mathematics everywhere is very low. When you talk about 50 per cent. one begins to think about honours; honour marks would be in the region of 50. Fifty per cent. for a pass would be ridiculous. I remember that when I was a student in college I used to get first honours in mathematics on something over 35 per cent.

881. *Chairman.*—Would not that depend greatly on the nature of the papers?—*A.* Yes; you could bring the level of it down to an extremely low one.

882. If you have a low level of paper, and have only the 25 per cent., you may get a very small amount of knowledge in your students?—*A.* If you say "I will not give any man a pass, or I will not give him a diploma of the college, unless he gets 50 per cent. in mathematics"—and I say also 50 in physics, because that is another heavy subject,—then you will get very few to pass.

883. *Mr. Leonard.*—Unless you lower the standard of the papers?—*A.* And then you will lower the standard so much that the Cooper's Hill diploma will not be worth the paper it is written on.

884. *Sir William Bisset.*—Do you propose that the 25 per cent. should apply all through? You would not be content with 25 per cent. on minor subjects? You would not apply it to all the more elementary subjects?—*A.* No, and we have not done so.

885. You must subdivide your percentage very much, because I am quite certain that no one could agree that any engineer should be admitted with a 25 per cent. knowledge of the minor subjects.—*A.* What do you call the minor subjects, though?

886. The elementary matter of algebra, arithmetic, and the minor trigonometry.—*A.* Those are all dealt with at the entrance examination. Of course, that is a different matter altogether; and when you raise the character of the entrance examination, that difficulty will disappear. Of course it would not do to apply it to them all.

887. I only mean to say that if you are going to keep your figures low, you must make it high in those parts which are necessary.—*A.* Yes, of course. Now in my subject of applied mathematics, men have to deal with such things as rigid dynamics and hydrostatics, and such a thing as the tensions and forms of wire ropes, the catenaries formed by wire ropes and things of that sort, and strains and stresses in systems of jointed bars, and our 25 per cent. is applicable to that. You could not possibly demand such a thing as 50 per cent. in those cases.

888. *Mr. Mansergh.*—Not with such a standard of paper as you think is desirable to be put to the students?—*A.* Undoubtedly. I know that it is desirable because I repeatedly get letters from old Cooper's Hill men in India sending me those problems to solve.

889. *Sir Alexander Rendel.*—If it is desirable that a man should know all these subjects, does a 25 per cent. minimum qualify him to be an Indian engineer?—*A.* A man who gets only 25 per cent. in mathematics at Cooper's Hill has a very bad chance of being an Indian engineer.

890. That is to say, the 12 men at the top always get more than 25 per cent.?—*A.* The 12 men at the top are nearly always rather strong in the mathematical branch.

891. What would be their range of percentage?—*A.* I am afraid I could not tell you that, but the first couple of men would get over 90 per cent.

892. Really?—*A.* Yes.

893. And the last couple of men?—*A.* That, I am afraid, I am not prepared to answer; say somewhere about 40 per cent. Of course, we have to recog-

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nise the fact that all men are not equally strong in mathematical subjects. The strength of one man is in, perhaps, purely descriptive engineering work, and things of that sort.

894. That is, the man who is low in mathematics may be high in physics, and so on?—*A.* As a rule the man who is low in mathematics would not be high in physics.

895. But he would be high in some other subject?—*A.* Yes, in some practical engineering subject. If I should not keep you too long I would refer to one other point, and I think it is the last point that I want to refer to, as far as I can remember.

896. *Chairman.*—What is that?—*A.* It is about the external examiners. I am an external examiner myself. I examine for the Indian Civil Service, Woolwich, Sandhurst, and so on; and I know that external examiners have no such faith in themselves as those who propose to appoint them have. External examiners do not come in contact with the students who are taught; they are groping about in the dark, and very often they set papers that are entirely inapplicable, useless papers. If a number of experts took up the Cooper's Hill examination papers, and took the examinations in mathematics set by external examiners—I will not say for the last three or four years at all, nor will I specify any number of years,—I would be able to show an unbroken series of years in which the kind of examination paper set by the external examiner is one which I would recommend a Cooper's Hill student to have nothing to say to, the kind of work set has been so inapplicable to the work of an engineer.

897. *Mr. Leonard.*—And to the teaching?—*A.* Yes, and to the teaching. I was talking about this subject to a man in London who has a great deal to say to external examiners, and who appoints them more than anybody else, I should think, in England. He said "the external examiner is a "nuisance, he nearly always upsets results, and the only way I can keep him "in order is to cut down his marks in such a way that they do not affect the "result; the external examiner knows nothing about the men, and the "proper examiner is the teacher." That is from a man who has the appointment of external examiners. So that the external examiner is by no means such a tower of strength as he is represented to be.

898. *Sir William Preece.*—On what page are the external examiners referred to?—*A.* On page 31 of the blue book you will see this: "The theory is that the external examiners are nominated by the President." Of course so they are. "The practice appears to have been that the professors have invariably put forward the names for the President's formal nomination." The President invites the people inside to name the examiners.

899. *Chairman.*—Who is examiner in mathematics?—*A.* Professor Greenhill is, at present.

900. Who nominated him?—*A.* Sir Alexander Taylor.

901. At whose suggestion?—*A.* No doubt at mine.

902. That is what Colonel Ottley means.—*A.* If it is not at mine at whose should it be? I mean that Sir Alexander Taylor would not dream of taking up a list of eminent mathematicians and writing off to them without saying what he was doing. He asked me to name a suitable man, and I said: "I "think Professor Greenhill is a good man; he is an engineer himself as well "as a mathematician; I think he is exactly the man we want."

903. *Sir William Preece.*—Has Colonel Ottley nominated anybody else?—*A.* No, I am merely saying that it must not be supposed from this that the people inside have taken away the President's power.

904. *Chairman.*—I do not think he meant that; I think that he meant that the President left it to them to suggest, and that he accepted whomsoever they suggested.—*A.* It is very good of the President, if he did; it only shows that he had confidence in me. I recommended to him a very good man, a most distinguished man.

905. *Sir Alexander Rendel.*—You do not object to him?—*A.* Certainly not.

906. Then it is possible to select an outside examiner who shall comply with your conditions?—*A.* It is quite possible to select such an outside examiner, but it is perfectly certain that he will make a considerable mess of his work.

for the first year, because he will not have become sufficiently acquainted with the kind of work that the men have been doing.

907. Does he have any previous consultation with you as to the nature of the papers he shall set?—*A.* He gets a syllabus of the work sent to him, and, of course, if he is a judicious man, he can keep strictly to the syllabus.

908. It is quite possible then to find an outside examiner who can carry on the work properly, at all events after experience?—*A.* Yes, perfectly possible.

909. *Mr. Leonard.*—But not probable, do you think?—*A.* A good examiner, a judicious examiner, is really one of the rarest things in the world. You may hit on a very good examiner, and you should be satisfied with him when you have got him. The chances are that if you make a change you will get a bad one; at any rate there is always an element of disturbance in the transition period, while this external examiner is making himself acquainted with the kind of work that is wanted.

910. *Sir Alexander Rendel.*—It means like most things, that a man must be judicious in selecting his examiner; that is what it comes to, is it not?—*A.* Yes, I suppose that is what it means.

911. What time does your lecture usually last; I mean the whole *séance* with your pupils?—*A.* It used to be two hours, now it is 1½ hours.

912. Taking the present time, how many students have you to attend to during the hour and a half?—*A.* At present I am given by Colonel Ottley a whole year to deal with each time, and so at present I have in the hour and a half 31 or so in one year, and 38 in another year.

913. That is to say a minimum of 30 men?—*A.* Yes.

914. And you are either lecturing to them or teaching them individually for the hour and a half?—*A.* Yes.

915. That means three minutes a man?—*A.* I will not admit that.

916. That is the average, is it not—you have got 90 minutes and 30 men, and on division that means three minutes to a man?—*A.* I will not admit that. The other day I was beginning the subject of hydrostatics to these men; it was a fresh subject and I was talking simply of the nature of liquid pressure; I was addressing 38 men for probably most of the hour and a half. Now, I maintain that I was teaching each man all that time, and that I was devoting an hour and a half to each man.

917. Quite so, but one is lecturing and the other is tutorial work?—*A.* Yes, but I think lecturing is teaching too.

918. Of that three minutes, how much will be lecture and how much will be tutorial work?—*A.* Of the three minutes?

919. Let us go back, if you will, to the hour-and-a-half. Of that hour-and-a-half how much will be lecture and how much will be tutorial work; that is, taking each man as he wants it?—*A.* That will depend on where we are in the subject. A few days hence, when we come to, say, the principle of buoyancy, probably the whole hour-and-a-half will be lecturing on the principle of buoyancy; then next day probably very nearly the whole hour-and-a-half will be individual work. Men will be given problems, and they will work on them, with an occasional address from me on each one. Whenever a problem is done by a majority of the men, I go up to the blackboard, and I resume the whole exposition of the thing; I work it out myself, and talk to them upon it.

920. Is that hour-and-a-half sufficient for the combined work of lecturing and individual teaching?—*A.* Yes, I think it is, if you give me smaller classes.

921. I suppose you cannot manage 30 men under such a system?—*A.* Not at all efficiently.

922. Then you must break up your classes?—*A.* Yes, and I hope they will be broken up.

923. Into practically one half of their present numbers?—*A.* Yes.

924. Then therefore your lecturing hours instead of an hour and a half will be three hours?—*A.* It will be an hour and a half, followed by an hour and a half some other time.

925. You must give three hours where you now give one and a half hours?—*A.* Yes.

926. Can you do that; have you physical strength enough to do the whole of that work?—*A.* Yes, plenty.

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927. Does it not come to this, that the course of three years is too short altogether?—*A.* That is a question that does not concern me. I am afraid that is a question that concerns parents and guardians. If you could induce the average parent and guardian to give his son at Cooper's Hill another year, to make it four years instead of three, I should be very much in favour of it.

928. That is to say, if he would spend 1,200*l.* instead of 900*l.* you would approve of it?—*A.* Yes, but I am afraid he will not do it. We can only do the best with what we have got.

929. How do you look upon Cooper's Hill; do you look upon it as a place for passing men, or as a place for getting honours? Is it a mere pass college, or is it a college intended for picked men who are to be equal to middling honour men at Oxford, or Cambridge, or Dublin?—*A.* Our primary object is to turn out perhaps some 15 really first class engineers every year, and to get the others up to as respectable an average as we can.

930. That is to say, Cooper's Hill is kept going for 15 men a year, in fact?—*A.* No, I would not say it was kept going for 15 men a year, because there are the fairly competent men who come below the 15.

931. *Sir William Preece.*—I have no question to ask you, but I should like to say that I have never heard anything but the very highest encomiums on the mode and the way in which mathematics is imparted to the students at Cooper's Hill.—*A.* Thank you very much.

932. *Chairman.*—There is one question I would like to ask you with regard to the appointment of external examiners. Is there not a circular issued to each examiner before he examines, suggesting to him a way of keeping up the standard, or of keeping an even standard?—*A.* There is a circular addressed to him, and he also receives a syllabus of the work.

933. What is the object of the circular; what does it tell him?—*A.* Of course it first of all invites him to act as examiner in a given subject. It states that the fee will be so and so, and that any further information that he desires with regard to the subjects of examination he will get by conferring with the Secretary of the College, who, of course, gets it from the professors of the subject. Then we send him a syllabus of whatever information we think is necessary. In the case of a new examiner he gets not only the syllabus but perhaps a letter with more detail; in the case of an examiner who has already been on perhaps two or three years that is not necessary.

934. Is he not told to keep up the average of the standard; is he not told to keep up an even standard of marks?—*A.* No, I do not think he is.

935. Not?—*A.* No, I do not think there is any such instruction given to him.

936. He is not told for, instance, that if the highest man of the year is below the average, a certain number of marks are to be given to him and also to all those below him, so as to bring up the standard to the average?—*A.* No, I do not think he is told that.

937. What is he told?—*A.* I do not think he is told anything that is of any importance at all. Sir George Chesney had a very curious notion which at first sight struck me as a very bad one, namely, that the man who came out first on any given paper was to be raised to the full marks, and the others were all to be raised in proportion.

938. That is what I believed; is not the confidential circular which is actually issued to each examiner to that effect now?—*A.* It was, but I think it was put rather problematically. It was not a command to him.

939. It was an invitation. I do not mean to say that it was a command,—*A.* It was not a command.

940. *Sir Courtenay Ilbert.*—It was a suggestion that it might be a good thing?—*A.* Yes; at first I thought it was an extremely bad notion of Sir George Chesney's, but I think that perhaps there is something to be said for it. He based it upon this principle, that the best student of a given year is much more likely to be at a constant level of ability and proficiency than the examiner. Speaking of the examiner, *qua* examiner, I think Sir George Chesney was quite right to say the examiner was likely to vary much more than the best student, and that his personal equation was very much greater than that of the best student. There was that to be said for it. I got rather talked over to Sir George's view finally; but we have abandoned that lately.

941. *Chairman.*—Quite lately, is it not?—*A.* Yes, quite lately we have abandoned that. *Prof. Minchin.*

942. Since Colonel Ottley came?—*A.* I think Colonel Pennycuick had a hit at it too. Of course, it is a kind of thing that strikes a new comer as it struck me. It struck me naturally as a very bad thing, as a sort of "fudging" of the results.

943. What I was coming to is this, you do not advocate the raising of the minimum from 25 to 50 per cent.?—*A.* No.

944. But with this minimum of 25 per cent., and with that circular in existence telling them to raise them all up, you might possibly pull in men on the 25 per cent. minimum who do not know anything at all or who know next to nothing?—*A.* That would be extreme, but you might pull them in from considerably below the 25 per cent.

945. You might pull them in from 10 to 15 per cent. I forget what the circular said exactly, and I have not a copy of it.—*A.* Of course it was not compulsory, and it was not always done. I did not always do it, and Sir George Chesney had a habit of hauling us over the coals if we did not.

946. *Sir Courtenay Ilbert.*—Have you heard of this curious system being adopted elsewhere?—*A.* I never heard of its being adopted elsewhere. Sir George Chesney used to hedge himself with this proviso—he used to say: "Provided you are satisfied that the best man is really up to the standard of what he ought to be."

The witness withdrew.

Professor ALFRED LODGE called and examined. *Prof. Lodge.*

947. *Chairman.*—What is your appointment at Cooper's Hill?—*A.* I am the Professor of Pure Mathematics.

948. We want to know from you whether you have seen the proposed changes in the curriculum with regard to mathematics?—*A.* I have seen the changes in the blue book, but I have not had any official information.

949. I am referring to the blue book. Have you any objections to urge against those changes, or any remarks to make upon them, because, if so, we should like to hear you?—*A.* I think that it would be a mistake to continue pure mathematics into the third year.

950. May I take it first that, as regards the stiffening of the entrance examination in mathematics, you agree?—*A.* Yes, I do. I should like to say with regard to the stiffness of the entrance examination that we have always felt that the entrance examination was not stiff enough for the work that was carried on in the College, but the President has always acted on the supposition that we have to keep the College fairly full—that is to say, the stiffness of the examination depends on the quality of the material that comes before us. For the last three or four years the standard has been gradually improving, but we have still kept the same subjects, and we have only been able to get men a little bit higher and of little better quality. We agreed last year, in consequence of the extra number of appointments probably attracting more men, that we might safely add more subjects to the entrance examination. The President spoke to us about it, and we agreed with him that we might manage to do it.

951. Practically you do not differ on that?—*A.* No.

952. The next point is to extend the course to the third year as regards your branch of pure mathematics.—*A.* I would like first to say one thing further about the entrance, and that is that I am afraid that this disaster, if I may call it so, impending is keeping some men away from the College.

953. That is a matter of opinion on which I do not think we can take your opinion, however true it may be; I want you to confine yourself entirely to the question.—*A.* It is a point with regard to raising the standard; it may not be possible this year.

954. I can merely take it as regards your teaching; do you prefer to have men brought in on a low standard, or on a higher standard?—*A.* Of course there is no doubt upon that, but it is a question of practical politics what standard you can get.

Prof. Lodge.

955. As to the course, that at present ends, as I understand, with the second year?—*A.* Yes.

956. Do you approve of extending it to the third year?—*A.* I think in pure mathematics, no.

957. Will you kindly tell us why you think not?—Of course, our mathematics is in a sense a subordinate subject, that is to say, our mathematical teaching is for the sake of enabling the men to do their applications of it which mostly take place in the third year. I think it will be far better, if we do increase the pure mathematics, to increase the amount given in the first year.

958. And not in the third?—*A.* I think not in that year. I agree with Professor Minchin that the applied mathematics might go on. That would keep up their acquaintance with mathematics. If the applied mathematics went on into the third year the pure mathematics need not, I think.

959. At present both stop?—Yes, both stop now.

960. You think the applied mathematics might go on?—I think the applied mathematics might go on. I should like more time in the first year, certainly, for my own course.

961. As to the size of the classes and the system of teaching—I will ask you afterwards as to the practice in the College—as a matter of principle do you think that the lecturing in large classes on mathematics is a good system, or do you think that the tutorial system should be adopted, or that a modified system of part lecturing and part tutorial teaching should be adopted?—*A.* Of course we are guided a good deal by the fact that the course is a competitive one, which prevents the classes being very small. I think I could manage better in the way I am going to suggest than in any other way, that is, by having some of the classes full, provided I could have some divisional lectures.

962. What do you mean by divisional lectures?—*A.* That means taking half the year.

963. A year would mean how many men?—*A.* It is less than 50; a year would be between 40 and 50, so that I should have something like 20, say, in the half-year. With that number I think I could do perfectly well without a tutorial assistant; I do not feel that he is necessary and he would be rather troublesome than otherwise.

964. You do not want him?—*A.* No; if I can have divisional lectures and more time I do not want him.

965. *Sir William Bisset.*—You want a little revision of the timetable in fact?—*A.* That of course means a little revision of the timetable. If they could give me two hours extra in addition to what is given there, I should be satisfied.

966. *Chairman.*—We are not paying any attention to this timetable in the Blue Book, because that is merely a suggestion.—*A.* If I could have two hours a week for divisional work, that is, two hours with each division, which would be four hours for me, I believe the first year work could be done very well, if that was in addition to what I have at present.

967. Do you feel competent to do that?—*A.* Yes. We used to do that before the present time. I used to have divisional lectures given in the first year and in the second.

968. How long did that last, up to what time did that go on?—*A.* I have records here since the Session 1891–92. In the first year I had either one or more divisional lectures right away till the Session 1896–97.

969. That was about the time when Colonel Pennycuick came, was it not, 1896–97?—*A.* I think so. Then in the Session 1897–98 I had a divisional lecture in the summer term, but not in the autumn term, but then I had four lectures in the autumn term instead of only three, as now. In the Session 1898–99, and in the Session 1899–1900, I only had a very unsatisfactory divisional lecture in the afternoon, given to a quarter of the men at a time. It wasted my time and it was not very satisfactory.

970. What is the cause of that?—*A.* The exigencies of the timetable; our timetable is so full that it is exceedingly difficult to get the time that is wanted at the best part of the day.

971. *Sir John Wolfe Barry.*—Are not all these matters adjustable between the professors and the President?—*A.* As a rule they are. Till the present

time we have had a hand in the timetable; at present we have no hand in it at all. *Prof. Lodge.*

972. *Chairman.*—Since when have you had no hand in it?—*A.* This session; in the autumn term. The new timetable was not seen by some of the staff until the day before the term began.

973. You do not mean the timetable that is printed in the Blue Book?—*A.* No, the timetable we are working to now.

974. You had no hand in that?—*A.* No.

975. No voice in it?—*A.* No voice in it whatever.

976. Who made it?—*A.* The President during the vacation, I understand.

977. *Sir John Wolfe Barry.*—Did the professors apply to have their views considered upon the timetable?—*A.* It was done during the vacation, when we had no chance of applying.

978. *Chairman.*—When you came back did you make any representations to Colonel Ottley upon it?—*A.* My part was workable.

979. *Sir William Bisset.*—I would like to ask a question about the percentage of qualification marks. It was stated to the Board of Visitors, and infact we are aware, that the qualification is 25 per cent.; to what branches of your subject does that apply?—*A.* That applies to the whole of the mathematics and the applied mathematics.

980. To the lower parts as well as to the higher parts?—It applies to the sum total of the two years' course.

981. And you have no sub-divisions?—*A.* No, not for qualification. I have worked out what the results would have been in past years if the 50 per cent., which we think is an impossible qualification, had been insisted upon.

982. *Chairman.*—What would have been the result?—*A.* More than half the men would have been disqualified till the year 1900, and then rather less than half would have been disqualified. As I have said, the standard is gradually rising.

983. If they had been disqualified, would they have been rightly disqualified?—*A.* No, I do not think so. We do not profess to turn out mathematicians. Some very good engineers, although they have a fair knowledge of mathematics, are not particularly good in that subject.

984. *Sir William Bisset.*—The point of my remark was that there are branches of mathematics in which certainly a higher standard than 25 per cent. is requisite?—*A.* Yes, that is so.

985. Do you make any discrimination in regard to those?—*A.* No, we make them come up to the total of 25 per cent.

986. *Mr. Leonard.*—Are you quite of opinion that 50 per cent is too high?—*A.* I am afraid it would be an impossible standard to try and keep to; it would mean, too, that we should have to work our subject down to the standard, I think.

987. Do you think it would involve issuing examination papers of a less severe class than they have now?—*A.* I am afraid that it would mean that, or else good men would be turned adrift.

988. I think I gathered from you that there is more difficulty in getting time for the students to work in than for the professors to lecture?—*A.* That is so.

989. That the professors would be, in some cases at least, willing to give more lectures if they could get the students?—*A.* We have struggled to get more time. For a long time I could only get two lectures a week with the second year. I applied time after time for more, and at last they managed to make it three. We very often had the two close together, and during the rest of the week the students——

990. *Chairman.*—Did nothing?—*A.* Forgot what had been going on. With three lectures in the second year I could do very well.

991. *Mr. Leonard.*—You really could do a great deal more lecturing if you had the opportunity?—*A.* If I had more divisional lectures, I would be content.

992. *Sir Alexander Rendel.*—How, if so much time has been given to private study, is there a want of time for lecturing?—*A.* There is no private study time for the first year and the second year, except in the evening. We have always considered that private study was important for the third-

Prof. Lodge.

year men, because they are learning their way in the world. In their fourth year they will be entirely on their own resources. We have considered right through the whole of the College history, so far as I can make out from Professor Minchin, that the third-year men should have a good deal of private study time. Of course it is filled up, but it is not filled up by class work. The first and second year men do not have private study time.

993. In mathematical examinations, I suppose, the higher subjects are marked higher than the lower subjects—you do not give an equal number of marks to each subject, do you?—*A.* The second-year work is marked a little higher than the first-year work, but not much higher.

994. If not, and if you pass a man at 25 per cent. all round, he may know the lower subjects very well, but he may know nothing of the higher subjects?—*A.* That is so.

995. Is not that a blot on a low minimum?—*A.* Yes, perhaps. I think we might possibly make it 25 per cent. on the second year as well as on the whole course; that might be an improvement.

996. Would you not give a regular gradation of marks—that is, give the highest marks to the highest subject taught, and then diminish downwards towards the lowest?—*A.* I think our present system has worked out very fairly well.

997. At 25 per cent. as a minimum, we will say, with arithmetic marked the same as the differential calculus, it may mean that the man knows nothing at all about the calculus?—*A.* Our marking has worked fairly well, because the man who has done well in the elementary subjects is generally the man who does well in the others.

998. It is better than it looks?—*A.* Practically it has worked out all right. It is the man who is weak in the elementary work who is also weak in the higher work; practically that is so.

999. It rights itself wrongfully in fact, rather?—*A.* Yes, that is so. But the subjects taken in the College course are trigonometry, analytical geometry, and the calculus; so that none of the subjects are very elementary.

1000. *Sir John Wolfe Barry.*—Are you acquainted with the standard of matriculation of the City and Guilds of London Institute?—*A.* I did see the papers some years ago, but I have not an accurate recollection of them.

1001. Then you cannot tell us how the matriculation standard at Cooper's Hill compares with that?—*A.* I should think it is very similar, but I do not remember exactly. I know that our entrance standard is too low, and has only been so low because the College had to be filled.

1002. Could you tell us how it compares with the Mechanical Science School at Cambridge?—*A.* There is no matriculation for the Mechanical Sciences School. Each College has its own entrance examination.

1003. Could you also tell us anything about the standard of qualification for, say, a third-class in the Mechanical Science School at Cambridge, a third-class in the tripos?—*A.* No.*

1004. You could not help us at all to compare?—*A.* No, I have not seen the papers.

1005. You do not know, I suppose, either what the minimum qualification is for a third-class at Cambridge—the minimum number of marks, I mean?—*A.* I do not, but I always understood that the minimum is very low indeed at Cambridge in mathematics.

1006. Do you think it would be advantageous that matters of the timetable, and things of that sort, should be discussed at College Boards, or that it would be preferable for each professor to approach the President personally on such matters?—*A.* I think in reference to drawing out a new timetable, the way we should have proposed ourselves would have been to have had a committee appointed by the Board who would draw out a timetable, and that that draft timetable would be submitted to the Board after having been on view before the various members of the staff for a considerable time. That is what we have generally done, and then if there are any objections, they can be arranged before the Board meet. Very little can be done at a Board meeting, but it can be done by a Committee of the Board quite easily.

* A prospectus relating to the Mechanical Science Tripos was subsequently put in by the witness. The qualification is on aggregate marks, not on separate subjects. The minimum is not mentioned.

1007. Somebody has to draw out a draft for discussion?—*A.* Yes. *Prof. Lodge.*

1008. That might be either drawn out by the President and discussed with the individual professors, or it might be drawn out by a Committee of the Board?—*A.* Yes.

1009. Either way the same result is obtained, that a draft is drawn out?—*A.* Yes; but it is easier to find fault with a draft that has been drawn out by a committee of the staff, than with a draft that has been drawn out by the President.

1010. You are able to criticise it more freely?—*A.* Yes.

1011. Still, for all that, a draft having been made, it is not a law of the Medes and Persians, and it can be altered by discussion?—*A.* Yes, of course, if it is merely a draft. I want to say one thing with reference to the new timetable. There are four evenings put down for tutorial classes.

1012. *Chairman.* Which timetable do you refer to?—*A.* The timetable in the Blue Book.

1013. I do not think it is worth while to go into that; it is merely Colonel Ottley's proposed timetable, and he may alter it to-morrow or the next day.—*A.* It is only as a matter of principle that I want to object to these classes.

1014. As it is a matter of principle perhaps you had better speak to it, if you put it like that.—*A.* It was only on the ground that at the evening class I am speaking of, from 9 to 10, four evenings a week, the students are not bound to be present and the professor would be bound to be present, and that does not seem to be quite a right position for him to be in.

1015. Why would a student not be obliged to be present?—*A.* It is put down as an optional class four evenings a week. As a matter of fact I have for years given one evening, but I have done it on my own initiative.

1016. Is that not a not uncommon thing; at least, I remember cases at Oxford in my time where a man used to say, "I will give you extra lectures on Latin prose or integral calculus if you like to come to my rooms"?—*A.* So long as I do it myself I should be most pleased to do it for whatever time is necessary. I do, as a matter of fact do so for one evening a week, but I should not like to feel that I was forced to be there in the evenings.

1017. And perhaps nobody turn up?—*A.* The students may please themselves. It seems to put me in a wrong position with regard to the students. I did speak about that to the President when he wanted me to do it this last year, and he was very nice about it, and withdrew it altogether. But I see it is in the Blue Book now, and that is why I spoke of it.

1018. *Sir William Preece.* It appears in the Blue Book as the accompaniment of the Report of 15th June.—*A.* I see. May I put in a statement that I have prepared? There is nothing personal in it (*statement handed in*).

1019. *Chairman.* There appears to have been a great improvement lately in the telegraph men?—*A.* This year we have got some good men in.

1020. Is there any reason for that?—*A.* I think the President has explained that the appointment is better than appears, and that the chances of promotion are greater. His persuasion has induced better men to come forward. But we had very bad batches for four or five years; we have had them down to the 30th on the list; in fact, there have been two men who were 30 on the list. In two cases we have had third-year men who were actually the lowest men who had qualified in mathematics, down to the 25 per cent.; they have been taken in because a man was wanted, and better men would not apply. I think the better men would not apply because they had been able to get good posts elsewhere, and they did not care for the telegraph appointment. For some years every man who has qualified has got an appointment that is worth having of some sort or another outside the telegraphs.

1021. *Sir Alexander Rendel.* The telegraph men are, in fact, the tail of the College?—*A.* For three or four years it has really been so.

The witness withdrew.

Mr. A. Hicks.

Mr. ARTHUR HICKS called and examined.

1022. *Chairman.* What appointment do you hold at Cooper's Hill?—*A.* I am Instructor in Geometrical Drawing and Lecturer in Estimating and Architecture.

1023. Are you responsible for the editing of the "Cooper's Hill Magazine"? —*A.* Yes.

1024. Will you tell me if you are responsible for the insertion of that letter by Colonel Pennycuick (*handing copy of magazine to the witness*)?—*A.* Yes, I am.

1025. Will you read that part which refers to the appointment of Dr. Brightmore?—*A.* "The arrangement actually adopted, though absolutely "bad in itself, might have been made to work properly if proper men had "been selected to work it, but when at the end of the session just com- "pleted, after more than a year's delay, the Secretary of State appointed as "professor of engineering and surveying, a gentleman who, though of "undoubted ability, did not possess the practical experience necessary for "the post, I declined to be a party to a measure which I consider inimical "to the interests of the College, and of the Department for whose benefit it "exists, and which at the same time inflicts a scandalous injustice upon "two able and valued members of the College staff, and have therefore "resigned."

1026. Who was that letter written by?—*A.* Colonel Pennycuick.

1027. It was written to "Engineering," was it not?—*A.* Yes.

1028. He was still acting as President of the College, when he wrote that letter, was he not?—*A.* Yes.

1029. When the letter was published in your magazine, was he acting as President?—*A.* I do not think so, but I am not quite sure.

1030. Was it your own idea to publish that letter in the magazine?—*A.* No.

1031. Whose idea was it?—*A.* Colonel Pennycuick's.

1032. Colonel Pennycuick suggested it?—*A.* Yes.

1033. The magazine is for the students, is it not, it is subscribed to by the students of the College?—*A.* By the students and past students of the College; principally it is subscribed for by those in India.

1034. It is read by the students in the College?—*A.* Yes.

1035. Do you think now, looking at it from a dispassionate point of view, that it was right to publish in the College Magazine a letter disparaging the qualifications of a professor newly appointed to the College, and accusing the Governing body of injustice?—*A.* No.

1036. Did it not strike you at the time, that you ought not to do it?—*A.* I had my doubts about putting it in. But if I might explain, it happened in this way. Just before Colonel Pennycuick left the College, which was, I believe, very shortly before the issue was made, a colleague of mine on the editorial staff asked him if he would write something for the magazine to explain why he was leaving the College, and he said, "I have written a "letter in 'Engineering,' publish that; that shows exactly why I have "resigned."

1037. So you published it?—*A.* So I published it.

1038. What was the effect of that on Dr. Brightmore's class?—*A.* I should not think it had any effect.

1039. No effect?—*A.* I should not think so.

1040. Did the students behave well in Dr. Brightmore's class, do you know? —*A.* It is only hearsay of course, but I believe they do not behave very well.

1041. That is only hearsay?—*A.* Only hearsay.

1042. Do they usually behave well in class?—*A.* Of course I can only speak for myself. I have no trouble with them at all.

1043. Do they behave well in your class?—*A.* Very well indeed.

Mr. A. Hicks.

1044. Colonel Pennycuick took the trouble to suggest the publication of this letter in your magazine; has he taken any part in the subsequent agitation?—*A.* Not to my knowledge.

1045. Have meetings been held of the College Staff during the past month at which Colonel Pennycuick attended?—*A.* Not that I am aware of at all.

1046. I suppose your department of teaching is not affected in any way by the proposed change?—*A.* Except that architecture is not to be taught in future.

1047. Does that affect you?—*A.* I used to teach architecture. There is one thing I should like to draw your attention to, if I may, with reference to that letter; I do not want it to be thought that I had any animus at all against Dr. Brightmore,——(*Sir Courtenay Ilbert.*) I quite see that yours was a very difficult position.—*A.* It was.

1048–9. *Chairman.*—So far as you are concerned, I think it was an injudicious thing to do.—*A.* I now think it was indiscreet; I own that.

The witness withdrew.

Dr. F. E. Matthews.

Dr. Francis Edward Matthews called and examined.

1050. *Chairman.*—What is your position at Cooper's Hill?—*A.* I am Demonstrator in Chemistry and Lecturer in Organic Chemistry to the forestry students.

1051. One of the proposed changes is only to retain one professor in chemistry, and we want to ask you if you think that one man could do the work?—*A.* I think it could be done, certainly.

1052. The time, we consider, must be reduced in consequence of the necessity of finding time for more essential studies, and we thought in that case that it was unnecessary to keep both you and Professor McLeod, and we wished to be satisfied that the work of teaching could be done by one man.—*A.* I have seen Colonel Ottley's proposals as regards the timetable, and the time would not be too much for one man, certainly.

1053. You think you could do it?—*A.* Yes, I have no doubt as to that. I might add that I merely came up to-day on Mr. Hicks's account, as I am co-editor of the magazine with him. I do not wish to speak; I merely came on his account, if there is anything to be said on the matter.

1054. As you are co-editor, I think it right to tell you what Mr. Hicks has told us, that he is responsible for publishing Colonel Pennycuick's letter in the magazine; do you accept joint responsibility with him?—*A.* Yes, to a certain extent, I suppose.

1055. I can ask you a question I asked Mr. Hicks. Was Colonel Pennycuick at the time that that letter was written, still acting as President of the College?—*A.* I really could not say.

1056. At the time it was printed in your magazine, was he?—*A.* He was certainly not.

1057. How came it to be printed. Was it your own idea, the idea of the editors to print it?—*A.* With regard to any matter of the College, we always go to the fountain head for information if we can get it, and as the matter was Colonel Pennycuick's retirement, he was approached and asked if he would write something for the magazine. He said "No, I would rather not "do that, but I am sending all the facts to 'Engineering,' and you can "reproduce that if you like."

1058. Do you remember the terms of the letter?—*A.* Yes, I have a copy with me.

1059. Look at the paragraph about the appointment of the Professor of Engineering and Surveying. I suppose the person to whom he refers, is clearly Dr. Brightmore?—*A.* Undoubtedly.

1060. And the authority to which he refers, as having committed a scandalous injustice—that is a pretty strong term—I suppose is the Secretary of State?—*A.* I presume it must be so.

1061. The Governor of the College?—*A.* Quite so.

Dr. F. E. Matthews.

1062. The object of the College, is to train men for the service of the Government of India, is it not?—*A.* Quite so.

1063. And a sense of subordination to authority, and a sense of discipline, are very essential for such service. I suppose you will admit that?—*A.* It is imperative.

1064. Do you think that this is a good lesson to give to students?—*A.* No, I do not. I frankly admit that it was an indiscretion to have published this, but there was no intention of casting any reflection upon Dr. Brightmore.

1065. Or, I suppose, upon the Secretary of State?—*A.* Or upon the Secretary of State.

1066. Then you accuse a man of scandalous injustice without any intention of casting any aspersion upon his character?—*A.* I beg your pardon, I did not accuse him.

1067. But you published the accusation?—*A.* It was published.

1068. You must accept the responsibility of publishing a libel if it is a libel?—*A.* Exactly. Of course you know there is an appreciative article in the same magazine as far as Dr. Brightmore is concerned.

1069. *Sir Courtenay Ilbert.*—This letter was inserted at the suggestion of your late principal?—*A.* Yes, that is so.

1070. And that fact placed you and your co-editor in a position of very great difficulty, did it not?—*A.* It did; the position was a difficult one.

1071. *Sir Alexander Rendel.*—I suppose it was not seen, that the publication of the letter in the magazine gave the *imprimatur* of the editors, and practically of the whole teaching body to it?—*A.* No, I think not.

1072. It was not noticed that that was the effect of publishing the letter?—*A.* No, it was quite overlooked. Any subsequent effect this letter might have had was never thought of, at the time—never dreamt of.

1073. *Chairman.*—Did any of the professors, when they saw this letter published, remonstate with the editors for publishing it?—*A.* No, I think not.

The witness withdrew.

Mr. PERCY GROOM called and examined.

Mr. P. Groom.

1074. *Chairman.*—What is your position in the College?—*A.* I am Lecturer in Botany and Entomology in the Forestry Department.

1075. Do the proposed changes affect you in any way?—The proposed changes in reference to chemistry and physics very gravely affect my department because I am the representative of science in the Forestry Department, and I notice on page 47 of the Blue Book that it sanctions the appointment of a Professor of Electrical Engineering to teach chemistry as well as physics. The chemistry must include inorganic chemistry, organic chemistry, the special composition of plants, and the physical and chemical characteristics of the soil.

1076. *Sir William Bisset.*—You are not quoting; you are giving us your interpretation?—*A.* It is to be found in the first paragraph on page 47: "The "instruction in chemistry, electrical engineering and physics should be under-"taken by the professor of electrical engineering."

1077. *Chairman.*—That must be a misprint.—*A.* The same proposition, differently worded, is put forward on page 42.

Sir William Preece.—We do not propose in any way to disturb the teaching of Dr. Matthews in your section.

Mr. Leonard.—That is the chemistry for the electrical engineers; it has nothing to do with the Forestry Department.

The witness.—It would have a very grave effect naturally.

1078. *Chairman.*—Is there any other point you wish to bring before us?—*A.* I have only two or three remarks to make with reference to physics and chemistry. The foresters in particular require a suitable course of physics, and the present system is one that I do not think is suitable; therefore in making any alterations I think that the Forestry Department should be considered. The present course is very unsatisfactory. It has been recently improved from the forester's point of view by Colonel Ottley, in that he has re-introduced light, which was excluded some years ago in order to make

room for additional electricity. The physics is now made up of heat, light, sound, electricity and magnetism; but the foresters require to be taught what I would like to describe as the properties of matter, they require to be taught such things as the diffusion of gases and liquids, osmosis, elasticity, transpiration. None of those things are at all taught in the physics course. Surface tension is taught in the second year in the applied mathematics course, and therefore it is unavailable to the foresters; and elasticity is taught in a course of applied mechanics, but that is an advanced technical course; so that no provision whatever is made for the special teaching of physics to foresters. I think that there should be a course of physics for foresters given by a physicist. [Mr. P. Groom.

1079. *Mr. Leonard.*—Do you think there ought to be another professor?—*A.* I do not suggest how it should be accomplished, but I think it is intended, as far as I can gather from the Blue Book, to make the teaching of physics rather more adapted for engineers. Such a course does not include the most important things for foresters, what they need is instruction in the properties of matter and light and a little heat, in addition to some mechanics.

1080. *Sir William Preece.* Who teaches physics now?—*A.* Professor Stocker lectures, and the practical work is done by him and Mr. Shields. But recently until this last year the lecture-course was only on heat, electricity, and magnetism; and I have had to interrupt my lectures to give students short digressions on physics.

1081. *Sir Alexander Rendel.* Are you capable of giving them such a course of lectures on physics as you speak of?—*A.* I have studied physics, and I am capable of giving for instance a ten minutes' account of surface tension, which I do not think is an adequate treatment of the subject.

1082. You are not a sufficient physicist to teach them?—*A.* No.

1083. *Sir William Preece.* I suppose Professor Stocker is quite competent to deal with that subject?—*A.* Certainly.

1084. *Chairman.* Is there anything else?—*A.* One point in reference to the chemistry I notice; I assume that the suggestion is to have one chemist. The chemist has to teach the four branches I have mentioned—inorganic chemistry, organic chemistry, the special chemistry of plants, and then he has to deal with the soil—that is, with the physical and chemical qualities of the soil. I suggest that there is no man who could keep up to date in all those branches. That is the only suggestion I have to make; I do not believe any man could keep up to date—I am sure he could not. Inorganic chemistry is a big branch, so is organic chemistry, and then the composition of plants is a very special work; and then there is this technical work of the physical and chemical characters of soils.

1085. Who teaches that now?—*A.* Dr. Matthews teaches three of them. Till recently we had an eminent specialist in Professor Church, teaching the composition of plants and the physical and chemical characteristics of the soil.

1086. In addition to Dr. Matthews?—*A.* Yes, Dr. Matthews took organic chemistry, so that till recently the subject of chemistry was divided among three men.

1087. How many men are there to be taught?—*A.* The foresters have varied in my short time from six to ten in each year, and 16 to 25 altogether.

1088. Do you think Dr. Matthews does not know these subjects?—*A.* No, I do not say that. I say it would be impossible, I think, for a man to keep up to date in all those branches.

1089. *Sir Alexander Rendel.* You mean to say that the Forestry Department requires the addition to the staff of how many more professors?—*A.* I do not suggest that; I simply say that one instructor in chemistry for the whole College, I think, could not keep up to date.

1090. *Sir William Preece.* But supposing that Dr. Matthews stuck to his present subjects and you had the course on physics which you suggest, do you want anybody else?—*A.* I suggest that there should be two chemists, because under the present proposal of retaining only one chemist I do not think that the chemist can adequately keep up to date. Of course he can give lectures.

Mr. P. Groom.

1091. *Sir John Wolfe Barry.* Dr. Matthews is thoroughly acquainted with what would be wanted for the students, is he not?—*A.* I have no doubt he is as regards organic chemistry.

1092. He has been doing the work?—*A.* He has been teaching the organic chemistry for some years, and I believe, has been listening to Professor Church's lectures on soils, at the same time acting as Professor Church's assistant.

1093. If Dr. Matthews tells us that he sees no difficulty in carrying out the work, would you not be rather disposed to take his view?—*A.* I confess that I should not.

1094. You know of course that inorganic chemistry is to be largely reduced and almost done away with?—*A.* Yes, and in reference to this shortening of the inorganic course I suggest that it puts the teacher in a dilemma.

1095. *Chairman.* The inorganic course has nothing to do with forestry, has it?—*A.* Yes, each forester takes this course.

1096. I thought the foresters took the organic chemistry?—*A.* They have to take both. They could not possibly do without both. If you shorten this inorganic course I think the lecturer is put on the horns of a dilemma. If he shortens the consideration of the general principles of chemistry and of the non-metals, then he largely takes away from the value of the lectures to the foresters; if on the other hand he reduced the course as regards the metals and such practical things as the composition of cement and boiler incrustations, then he diminishes the value from the point of view of the engineer. May I add that Professor Minchin forgot to leave behind a time-table which he has asked me to hand in. It is in reference to a statement made in the Blue Book as to the hours of private study in General Chesney's time. (*Handing in table.*)

The witness withdrew.

Adjourned.

APPENDIX 1.

Royal Indian Engineering College.

Particulars of Appointment, Emoluments, &c., of Retiring Professors, Lecturers, &c.

Name.	Approximate Age.	Date of Appointment.	Previous Employment.	Terms of Appointment.	Remuneration.	Subjects Taught.	Average Number of Hours Teaching per Week.	Terms of Retirement.
Professor H. McLeod, F.R.S.	60 years	1 May 1871 (as Professor of "Physical Science").	Assistant Chemist, Geological Museum, South Kensington.	Appointment terminable at pleasure at one term's notice on either side. Pension under Superannuation Act.	Salary, 600*l.* Allowance for fuel and gas, 35*l.* Honorarium for Analytical Laboratory, 50*l.* House valued at 120*l.* per annum.	Inorganic Chemistry (including practical work in Laboratory).	13·7 (+100 hours Advanced Chemical Laboratory during Easter term.)	Gratuity 185*l.* Pension 466*l.* 3*s.* 7*d.* per annum.
Mr. A. H. Heath, A.M.I.C.E.	54 „	30 Aug. 1875	Great Northern Rly.	Ditto	Salary, 450*l.* Fuel and gas, 35*l.* House valued at 100*l.* per annum.	Descriptive Engineering. (During the last year Mr. Heath has assisted in the teaching of Surveying.)	Engineering, 3·6 (Superintends project and railway station design).	Gratuity 135*l.* Pension 273*l.* 9*s.* 9*d.* per annum.
Professor W. N. Stocker, M.A.	50 „	23 June 1883	Senior Demonstrator, Clarendon Laboratory, Oxford University.	Appointment terminable at one term's notice on either side. No pension claimable.	Salary, 450*l.* Quarters valued at 32*l.* per annum.	Physics (including practical work in Physical Laboratory).	17·8	Gratuity 125*l.* Pension 120*l.* per annum.
Professor T. A. Hearson, M.I.C.E.	52 „	29 Sept. 1884	Instructor in Applied Mechanics and Engine and Boiler Design at the Royal Naval College (1873–84). Obtained commission in Royal Navy in 1871.	Ditto	Salary, 600*l.* House valued at 120*l.* per annum.	Hydraulic Engineering (with superintendence of Mechanical Laboratory).	10·0 (excluding time spent in Mechanical Laboratory and Mechanical Design).	Gratuity 165*l.* Pension 150*l.* per annum.
Mr. T. Shields, M.A., B.Sc.	33 „	20 Jan. 1892 (as Demonstrator in Physics). 28 Sept. 1897 (as Instructor in Electrical Engineering also).	Yorkshire College, Leeds.	Ditto	Salary, 400*l.* (Mr. Shields' original salary as Demonstrator in Physics was 250*l.* This was increased by 150*l.* when he was appointed Instructor in Electrical Engineering.)	Electrical Engineering (Demonstrator in Physics.)	17·0 (+15 hours per week for 15 weeks with Electrical Engineers.)	Gratuity 525*l.*
Mr. J. C. Hurst	72 „	Feb. 1881	War Office	(Not defined)	Fees, 5 guineas per lecture	Accounts	Gives 15 lectures a year (during Autumn and Easter Terms).	Gratuity 50*l.*
Mr. R. Reilly	40 „	26 Sept. 1884 (There was a break of over 2½ years—Jan. '88 to Aug. '90—in Mr. Reilly's service).	(Not known)	Terminable at one month's notice. No pension claimable.	Salary, 150*l.* (Also fees for tests in Mechanical Laboratory when these exceed a certain number.)	(Demonstrator in Mechanical Laboratory.)	About three hours a time for 40 or 50 attendances in the year, say 150 hours a year.	Gratuity 75*l.*

12th March 1901.

APPENDIX 2.

General Statement by Retiring Professors.

The dislocation of the work consequent on so many simultaneous changes in the staff, intensified by the fact that they take place before the end of the session, is seriously to the disadvantage of the students, for the courses of the lectures will be left incomplete.

The reason given for our dismissal was "with a view to reducing the "present excessive cost of the staff and increasing the efficiency of the "teaching." With regard to the excessive cost we wish to submit a balance sheet, showing that there is no appreciable diminution in the cost. We also wish to point out that since 1895 the staff have themselves diminished the cost of the teaching; for example, General Courtney retired and his work has been taken up by the remaining resident staff. Work done in 1895 by five outside lecturers has been gradually absorbed by the residents, about 1,000*l.* a year has been saved in this way. This does not look as if the staff were unwilling to work, as is suggested by the remark on page 23. References to Appendices C. and D. will confirm this statement.

With regard to efficiency we do not believe that the proposed scheme will work.

The new scheme seriously diminishes the number of teachers in science, and we are authorised by the Mathematical Professors to say that it unnecessarily overloads their subject.

We do not think that one professor with a tutorial assistant can possibly efficiently teach the whole range of mechanical, hydraulic, and constructive engineering, with railway and canal management, and supervision of the mechanical laboratory and workshops.

We do not think that one practical instructor on 300*l.* a year can teach physics, chemistry, and electrical engineering.

We do not believe that the costly moving of the mechanical laboratory will result in economy, since the old mechanical laboratory is to be used for other work, and will require a separate staff as heretofore.

We do not believe that the instruction and testing work in the new mechanical laboratory can be done without a demonstrator.

On Monday last a letter was sent to the President containing the following sentence, "We trust that you will give directions to the Secretary to give us "all facilities for referring to the Board Minutes and to other documents in "the office." Yesterday some of us wished to see some documents, not of a confidential character, but the Secretary said that he had orders not to give them without a written order from the President, who was away from home, so we have been unable to obtain some information that we required.

Financial Effect of the Changes.

Deductions from Annual Expenditure.	£	s.	d.	Additions to Annual Expenditure.	£	s.	d.
Professor Hearson	600	0	0	Professor Hearson, pension	150	0	0
Mr. Heath	485	0	0	Mr. Heath, pension	273	9	9
				Assistant to Dr. Brightmore	450	0	0
				Surveyor	450	0	0
Professor McLeod	685	0	0	Professor McLeod, pension	466	3	7
Professor Stocker	450	0	0	Professor Stocker, pension	120	0	0
Mr. Shields	400	0	0	New instructor in electrical engineering	300	0	0
Mr. Reilly	150	0	0	Two mathematical instructors	500	0	0
Mr. Hurst	78	15	0	New accounts instructor	78	15	0
					£2,788	8	4
				Saving	60	6	8
	£2,848	15	0		£2,848	15	0

The changes will leave three vacant houses and Professor Stocker's rooms.

Those rooms will be required for the new instructor in electrical engineering, who is to have free quarters.

One house will be available for Dr. Brightmore, and will permit of an additional saving of 100*l.*, his house allowance.

As outside lecturers in electrical engineering are to be appointed, the whole annual saving shown above of 160*l.* will be more than swallowed up.

The total amount of the gratuities granted:—

	£
McLeod	185
Heath	135
Stocker	125
Hearson	165
Shields	105
Reilly	75
Hurst	50
Shields also	420
	£1,260

APPENDIX 3.

STATEMENT by Mr. T. SHIELDS, M.A., B.Sc, &c., Lecturer in Electrical Engineering and Demonstrator in Physics.

Royal Indian Engineering College,
Cooper's Hill,
14th March 1901.

The proposal that electrical engineering should be compulsory for all students is not new. A scheme was considered in 1895 by Professor Minchin, Professor Stocker, myself and others with this object, and the result was submitted to the President in a proposal written by Professor Minchin. The staff fully recognised the importance of the subject and were very desirous to carry out the proposed scheme, which, however, was not even forwarded to the India Office by the President. The present course is a compromise. Under it every student spends 100 hours at electrical work (lectures and practical), while those who elect to take up the alternative course (generally the best men of their year) have a total of 325 hours at the subject. Under Colonel Ottley's scheme 230 hours only will be available, and even this will probably have to be cut down to find time for French and German. It is difficult to see, therefore, how the subject which is described by Colonel Ottley as hardly taught at all at present is going to be more thoroughly covered in much shorter time.

2. I append the syllabus of the practical course in electricity at University College, London, together with the comparison with the course at present carried out at Cooper's Hill. It will be seen that the Cooper's Hill course is a very comprehensive one and compares favourably with that at University College, and that the description applied to it by Colonel Ottley is absolutely unwarranted.

3. There has been no proposal or suggestion made to me on the part of Colonel Ottley, or any previous President, that the course should be modified in any way. There are no doubt some things which might be advantageously taught, but which find no place in the present course, and those responsible for the teaching have always been perfectly ready to carry out any suggestion possible from people who are in a position to advise. As a matter of fact the course is modified from year to year somewhat, but all such alterations have to be carried out on the most modest scale, for the simple reason that there is no annual grant whatever towards the expenses of the electrical course. All new apparatus, material, repairs, &c., have to be paid for out of the physics grant. The subject is, therefore, seriously crippled financially.

4. As to the recommendation that the instruction in physics, chemistry, and electrical engineering should be undertaken by the Professor of Electrical Engineering (a thoroughly practical man), the Board will find it impossible to get one man to do it all. What electrical engineer would undertake to give theoretical and practical instruction in inorganic chemistry, organic chemistry, the chemistry of soils, the chemical physiology of plants, heat, optics, acoustics, theory of electricity and magnetism, and of dynamo-electric machines, &c., in addition to the work which he has been trained for? This suggestion alone is enough to convince people familiar with scientific teaching how ill digested the scheme is. Moreover, the work is so arranged in the timetable that it is impossible for one man to do it, even if he were not expected to teach chemistry.

5. There is a serious objection to a "practical man" being selected to teach the principles of a subject like electrical engineering. If there is one branch of engineering that specially requires a knowledge of higher mathematics and dynamics, it is electrical engineering, and the "practical

man," however familiar he may be with the applications of electricity, will find himself hopelessly at fault when he is exposed to cross questioning on the part of students of considerable mathematical attainments on points of theory involving a knowledge of the calculus and differential equations.

6. Another effect of the proposed changes in this Department, as in other departments, should not be lost sight of, the new proposals seem to aim at producing a course specially suited to the direct needs of the Public Works Department Engineers. It should not be forgotten that the College depends on other men than those desirous of the Public Works Department appointment. More than twice as many men are admitted as Engineer students than there are Public Works appointments for, and as a matter of fact the College has been advertised, for at least the last 12 years, as furnishing an education which fits an engineer for employment in Europe, in the Colonies, and in India. Under the new scheme it cannot be expected that men who are desirous of receiving a thorough scientific general engineering training will present themselves at Cooper's Hill.

7. There is another objection, as regards this Department, in connection with the new arrangements made for the teaching of mathematics. The study of pure mathematics is continued to the end of the third year; this is clearly a mistake. If his mathematics are to be available as a weapon with which to tackle the problems presented in study of electricity and other subjects, it is clearly essential that the pure mathematical course should be condensed into the first two years. This argument applies to other subjects as well.

8. There are several points in the timetable with reference to my subject which must be noted. First, in the first half session there is an arrangement by which the second-year men are given in quarter divisions 50 minutes practical instruction in physics per week. This period of time is absolutely useless for the purpose, and should therefore be deducted from the number of hours set apart for instruction in this subject. Secondly, the one and a half hours allotted in the third year for the same purpose is absolutely inadequate and comparatively useless. This allotment of time for practical physics could only have occurred to one who was absolutely ignorant of the nature of the subject, and the conditions under which it must be taught.

As regards the personal question :—

1. I was appointed demonstrator in physics in January 1892, more than nine years ago.

2. The extended electrical course was instituted in Session 1896-97, and was carried on by Professor Stocker and myself during that session without additional remuneration.

3. The work mainly falling on myself, I applied to the Secretary of State in the summer of 1897 for an increase of salary of 150*l.* a year, and the additional designation of Lecturer in Electrical Engineering. In connection therewith, I submitted to the President a statement of my training and qualifications, which satisfied him that I was competent to undertake the instruction in the subject. In September 1897, I was appointed Lecturer in Electrical Engineering by the Secretary of State, and my salary was increased by 150*l.* a year. This appointment I have continued to hold.

4. My teaching has been, as my colleagues are ready to bear witness, successful, and the course of instruction for which I am to a great extent responsible has attracted each year the best students of the College.

I am now apparently dismissed because I am not considered competent to teach the subject.

5. Colonel Ottley is not in a position to say whether I am qualified or not. He has not endeavoured to make himself acquainted in any proper manner with the instruction given. I know that Professor W. E. Ayrton paid what was practically a secret visit to Cooper's Hill in November 1900, on the

invitation of Colonel Ottley. There were invited to meet him (1) a new telegraph student, (2) the Superintendent of the mechanical workshop, (3) the telegraph workshop mechanic. These men were questioned as to the instruction which the students received from me in the physical laboratory and the dynamo room. Not one of them was in any way capable of giving him any reliable or even intelligent information as regards the instruction given, far less of giving him any accurate idea of the course. No one (neither Professor Stocker nor myself nor any of my colleagues) was invited to meet Professor Ayrton who could give him such information. I most emphatically protest against any action being taken as regards myself which is based on any report which may have been made by Professor Ayrton.

I submit that no evidence has been shown which points to any inefficiency on my part in the past, nor to any inability to carry out the proposed changes in my subject. I must emphatically submit that no pecuniary compensation can possibly recompense me for the slur which has been cast on my reputation by the manner of my dismissal. This action will render it practically impossible for me to secure a similar appointment elsewhere, thus depriving me of the opportunity of earning my livelihood by the exercise of my profession.

University College, London.

Electrical Laboratory Course.

C.H. 1. Exploration of magnetic fields.
C.H. 2. Magnetic field of a circular current.
C.H. 3. R. F. by water voltameter.
C.H. 4. Slide bridge resistance.
C.H. 5. Calibration of ballistic galv^{s}.
C.H. 6. Determination of magnetic field strength.
C.H. 7. Experiments with Standard magnetic fields.
8. Interpolar field of electro-magnet for varying lengths of air gap.
C.H. 9. Res. and temp. coef^{t} by Wheatstone's Bridge (P.O.B.).
C.H. 10. E.M.F. by potentiometer.
C.H. 11. Current by potentiometer.
12. Complete test of primary battery.
C.H. 13. Calibration of voltmeter by potentiometer.
C.H. 14. Photometry, glow lamp.
15. Absorption of semi-transparent screens.
16. Reflection of various surfaces.
C.H. 17. Electrical efficiency of small motor.
C.H. 18. Efficiency test of a motor.
19. „ „ motor dynamo.
C.H. 20. Test of a gas engine and dynamo plant.
C.H. 21. Sp. Res. of a wire.
C.H. 22. Low Res. by potentiometer.
C.H. 23. Armature resistances.
C.H. 24. Standardising ammeter by copper sulphate.
C.H. 25. „ voltmeter by potentiometer.
C.H. 26. „ ammeter by potentiometer.
C.H. 27. Determination of magnetic permeability of iron.
28. Standardising a high pot^{l} voltmeter.
29. Examination of alternate current ammeter.
30. Delineation of alternate current curves.
C.H. 31. Efficiency test of transformer.
32. „ „ alternater.
33. Photometry: arc lamp.
C.H. 34. Meas^{t} of insulation of high res^{ces}.
C.H. 35. Efficiency test of a secondary battery.
36. Calibration of electric meters.

C.H. 37. Hysteresis curves of iron.
C.H. 38. Examination of a sample of iron for hysteresis loss.
C.H. 39. Capacity of concentric cable.
40. Hopkinson test of a pair of dynamos.

The operations marked C.H. are common to the two courses. In addition the following operations are included in the Cooper's Hill course :—

1. Res. of coils ; temp^{t} coef^{ts} by differential galvs.
2. „ „ „ Carey Foster's method.
3. Res. of electrolytes by alternating current method.
4. „ „ condenser method.
5. Res. of earths (lightning conductors, &c.).
6. Insulation res. of insulators, cables, &c.
7. Construction of standard coils.
8. E.M.F. in volts (Kelvin's method).
9. Construction of standard cell.
10. Polarisation of cell.
11. Comparison of capacities by discharge method.
12. „ „ mixtures method.
13. Abs. cap^{s} and study of leakage and residual charge of condensers.
14. Det^{r} of mechanical equivalent of heat.
15. Magnetic qualities of iron by Rowland's method.
16. „ „ „ Permeameter method.
17. Det^{n} of inductances by Rayleigh's method.
18. „ „ Anderson's method.
19. „ mutual inductances by Carey Foster's method.
20. E.M.F.'s and internal res. of accumulators.
21. Efficiencies of acc^{rs} (quantity and energy).
22. Construction of acc^{rs}.
23. Dynamo : Mag^{c} distribution in A^{r} core.
24. „ External ch^{c} of shunt dyn^{o}.
„ Total ch^{c} of shunt dyn^{o} ; H.P. curves.
25. „ Internal ch^{c} of shunt dyn^{o}.
26. „ Armature ch^{c} of shunt dyn^{o}.
27. „ Compounding from B^{r} ch^{c}.

Also motor, alternator and transformer work on next page.

Electrical (Practical) Course.

Branch IV. Work.

Measurements of resistances: Coils.
Electrolytes.
Cells.
Insulators.
Cables.
Construction of Standard coils.

E.M.F.'s: Potentiometer methods.
Balance and Standard Coil (Kelvin).
Construction of Standard E.M.F.'s.
Standardising Voltmeters.
Polarisation of Cells.

Standardising, Ammeters by Electrolysis of—
Cu. SO_4.
Hg. NO_3.
Potentiometer Method.

Condensers: Capacities by.
Various Methods.
Absolute Capacity.
Study of Leakage.
Residual Charge.

Determination of Mechanical Equivalent of Heat.
" " He & M (Gauss)
" " I, H, N, &c. (Ewing).
" " B, H, M, &c. (Rowland).
" " " (Parmeautch).
Inductance of Coils (Rayleigh).
" " (Anderson).
Mutual Inductance of Coils (Carey Foster).

Branch I. Work.

Measurement of Small Res^{s}:
(1.) C. & E.
(2.) Fall of potl.
Accumulators:—
E.M.S. and Internal r^{es}.
Charge and Discharge of.
Efficiencies (Energy and Quantity).
Construction and Testing of.
Photometry:—
Compression of B.S.C. and Methven Slit.
C.P. and Resistance of Glow Lamps.
Efficiencies of Glow Lamps.
Dynamo:
Measurements of Dynamo Const^{s}.
Magazine Distribution (potl. round communicator) for no load and full.
Shunt Wound: External Characteristic.
Total.
H.P. Curves.
Internal Characteristic.
Armature of Characteristic.
Compounding from A^{r} Ch^{e}
Compound Wound: External and Total Characteristics.
Efficiency of combined Gas Engines and Dynamos.
Motor:
Magnetic Curve.
Stray Fields; Leakage Coefficient.
E.M.F. & Counter E.M.F. of Series, Shunt and Compound (Short and Long Shunt) Wound Motor.
Efficiencies.
Alternator:
Magnetic Curve.
External and Total Characteristics.
&c.
Transformer:
Step-up and step-down transformers.
Ratios of Transformers.
Efficiencies at various loads.

Proposed Distribution of Marks.

Branch IV.;—	
Internal Examiners:	
Practical Examination	30
Mathematical Examination	20
External Examiners:	
Practical Examination	60
Note Books (Branch III. Work)	30
Paper of Branch IV. Work	40
	180
Branch I.:—	
Internal Examiners:	
Practical Examination	30
Paper on Branch I. Work	30
Paper on Dynamo Lecture	40
External Examiners:	
Paper on Branch I. Work and Dynamo Lectures	50
Note Books (Branch I. Work)	30
	180

Present Arrangement.

Branch IV.:—	
Internal Examiners:	
Practical Examination	50
Mathematical Examination	20
External Examiners:	
Practical Examination	60
Note Books	50
	180
Branch I.—	
Internal Examiners:	
Paper on Branch IV. Work	40
Paper on Dynamo Lectures	50
External Examiners:	
Paper on Branches IV. and I. Work	40
Paper on Dynamo Lectures	50
	180

APPENDIX 4.

STATEMENT by W. N. STOCKER, Professor of Physics, Royal Indian Engineering College.

Cooper's Hill,
14th March 1901.

Conditions of Appointment as to work to be done.—Appointed in June 1883. Subjects to be taught:—Electricity and magnetism, the theory of heat, and their practical applications, also the theory of light and sound. These subjects to be treated mathematically and experimentally. To be assisted by a demonstrator and a lecture assistant.

Probable number of lectures a week, two, covering the course in from 60 to 70 lectures.

Laboratory to be open for five days in the week to supervise the special studies of those students who are preparing themselves for employment as telegraph engineers, and to instruct them in telegraphy.

Original Course.—At first the work consisted of—

Lectures.—One a week to first year for three terms, 30; one a week to second year for two terms, 20.

Laboratory.—Three hours a week for second year, 90; and about 120 hours for third-year students, consisting entirely of electrical work, 120.

About eight hours a week for telegraph students, signalling and electrical testing.

Course altered and "extended" so as to introduce more Electricity.—In the above short course of lectures it was very soon found necessary to omit "sound," "light" following about nine years later in order to get more electrical work in. In 1896 the second-year course was, at my own suggestion, continued during the summer term, so that latterly the lecture course has been—

First year:—20 lectures on heat; 10 lectures on electricity and magnetism.

Second year:— 30 lectures on electricity and magnetism.

Laboratory and Electrical Engineering Course.

Laboratory Buildings and Plant extended.—Shortly after Mr. Shields' appointment in January 1892, the electrical course was considerably improved by an extension of the buildings, and the purchase of a new direct current dynamo, an alternator, transformer, motor, new secondary battery of 54 cells, &c.

General Electrical Engineering Course proposed by present staff.—In 1895 an attempt was made to make electrical engineering compulsory on all students; it fell through owing to a difficulty in obtaining the necessary time, but as a result the third year students, taking up physical laboratory work as an alternative subject, had their number of hours doubled. and this extended course was called electrical engineering.

Increase of third year's work.

At present the time given to the subject is as follows:—

	Lectures.		Laboratory.	
	Heat.	Electricity and Magnetism.	Heat and Light.	Electricity and Magnetism.
First year	20 hours	10 hours	—	—
Second year	—	30 hours	30	60
Third year (alternat ve).	—	40 hours	—	185

i.e., each student has 20 lectures on heat and 40 on electricity and magnetism; and in the laboratory 30 hours on heat, &c., and 60 on electricity and magnetism; and if third year's work is taken, 225 on electricity and magnetism.

In addition to this the telegraph course has to be arranged for.

The above will show that the present staff have tried to increase the efficiency of the teaching of the subject, and to keep it up to date, and that they have not shirked additional work.

Change of Work without Consultation.—This session I found that my lectures on physics, &c., to first-year students had been increased from one to three a week, having received no previous intimation to that effect. I was not informed how many lectures altogether I was likely to have, so that under the circumstances it has not been possible to give a very satisfactory course. Add to this that the first-year men on entering have not sufficient mathematical knowledge to follow properly an extended course of physics.

Suggested Time-table.—According to the President's suggested time-table, as seen first in the Blue Book, it appears that in the three years' course each student will get 189 lectures, viz., 60 on heat, light and sound, and 129 on electricity; and in the laboratory about 102 hours, making a total for physics and electricity of 291 hours. At present to the same subjects 375 hours are devoted by special students, and 150 hours by all students. Hence the gain to the subject in the case of the best men is not obvious.

Number of hours allotted to physics and electricity.

No improvement in case of best men.

Times assigned to Physical Laboratory too short to be useful.—On entering into details, it appears that "physical laboratory" for half the second year means 50 minutes a week, and for the third year one and a half hours a week, times utterly inadequate, as anyone who knows anything about the subject will allow.

The time allotted to lectures is excessive when compared with that allotted to practical work.

In the first half of the session 10 lectures are put down per week, seven on electricity, and three on physics; really only five on electricity, as two are put down for half-years only, a very inconvenient arrangement in the case of experimental lectures.

Impossible arrangement of lectures.—On Tuesdays and Thursdays the lecturer is expected to lecture on electricity and physics simultaneously to the third and first years, followed, after lunch interval, by a lecture on electricity to the second year. A similar arrangement of two experimental lectures following on one another occurs on Wednesdays.

The total time allotted to the lecturer in this part of the session appears to be 21 hours per week, perhaps not excessive; but it must be remembered that 10 experimental lectures and 11 hours laboratory imply a considerable amount of additional time spent in preparation.

More than one man's work.—I doubt any one man being capable of doing the work efficiently, even without the additional task of teaching chemistry.

Mr. Shields.—In conclusion I wish to state that when Mr. Shields was a candidate for the appointment of Demonstrator of Physics here he was specially selected from five applicants, because of his practical knowledge of electrical work and experience in electrical engineering, and I think that as a result the teaching of electrical engineering here compares very favourably with that given in other colleges.

APPENDIX 5.

Statement by Professor McLeod.

It appears to me that the proposed changes will seriously affect the teaching of chemistry. In Colonel Ottley's Report (p. 27 of the Blue Book) it is stated that engineers only need sufficient knowledge of chemistry to enable them to interpret the results given them by "professional chemists." I believe that it would be difficult, if not impossible, to frame a syllabus that would cover this standard and which would not go far beyond it.

Perhaps it might be convenient to state what is the course at present in vogue and which it is proposed to modify.

Chemistry is an obligatory subject for students of the first year (including the forest students). There are two lectures a week in the autumn and Easter terms, and one lecture a week in the summer term, making about 50 lectures a year. Each student attends the chemical laboratory once a week for three hours, and as there are about 30 weeks of lectures in the session, the laboratory course extends over 90 hours, or 15 days of 6 hours each.

The course of lectures is on elementary inorganic chemistry, and I am obliged to treat the students as beginners, for many of them enter the College with little or no knowledge of the subject. The attention of the students is directed to any matters that are likely to be of special interest to them in their profession as engineers or foresters, but the course cannot be called a technical one. I have thought it my duty to endeavour to teach the fundamental principles of the science, which they should be able to apply when occasion requires. The course is essentially the same as that with which I commenced at Cooper's Hill, and which had the sanction of Colonel Chesney, who is so often referred to as an organiser and economist, and who was also an educationalist. He attended several courses of my lectures and never expressed disapprobation. There have naturally been additions and omissions made, consequent on advance of knowledge. I have always been glad to introduce into the course any subject that my colleagues have considered advisable, but as the members of the staff do not frequently meet, at the present time, to discuss the educational work of the College, we are prevented from having that interest in the work of our colleagues which would be of such value in an institution like ours.

The laboratory work consists of a course of qualitative analysis, and, without going into detail, I would only say that endeavours are made to teach the students not only the analytical methods, but, in addition, all the principles which underlie them, and to impress upon them the necessity of closely observing the relations of cause and effect. This, independently of the chemical facts acquired by the students, appears to me to be of great value to them as a course of education, and is calculated to exercise their reasoning facilities; thus, I never answer a question by a student if I think that he should be able to find it out for himself, which I help him to do. The instruction is, therefore, largely examinational, the men hate it, but it is good for them. I adopted this system in consequence of a remark of Colonel Chesney's, that we should hear the students as much as the students should hear us. At the end of the course a student, who has worked reasonably well, is able to analyse almost any simple substance given him.

The timetable suggested by Colonel Ottley, provides for two lectures a week in the first half of the first year, that is about 30 lectures instead of 50. There are also two hours laboratory work a week during the same period. Chemistry is then dropped for twelve months, and in the second half of the second year, although there are no lectures on the subject, three hours a week are given to the laboratory, making a total of 75 hours in the whole course. The reason for dividing the chemistry into two parts is not obvious, and is at variance with the practice in other educational establishments, where a subject is carried on continuously until completed, and then the examination is held, a principle which has been maintained at Cooper's Hill since 1875.

From 1884 to the end of last session the chemical laboratory was open on four days in the week, two for obligatory attendance of first-year students and two for optional attendance of first and second years; this was often a great help to those of the first year who were backward in their work. The timetable in force this session provided for four obligatory days for the first-year students, each class consisting of about 12 students, this was necessitated by the students having to attend the workshop in classes of 12. As one of the days was Thursday, which has always been a free day for me since my appointment, I requested the President to make an alteration, and as Wednesday is no longer available, the work closing at 2 on that day, a whole division now attends on Monday. In consequence of other optional work, it is impossible for first-year students to avail themselves of the optional hours which extend until 6 on two afternoons in the week.

The curtailment of the course as now suggested will, I think, be prejudicial to the efficient teaching of the subject, especially if it is to be taught by the professor of electrical engineering, who will also be responsible for physics.

I would beg to remark on a sentence in Colonel Ottley's letter No. 16, p. 50. "Mr. McLeod has been here for nearly 30 years, for the first 12 of "which he taught the natural sciences without the aid which was subse-"quently afforded." During those 12 years I lectured in alternate years on chemistry and experimental physics, the first and second year students attending the lectures together; there was no physical laboratory work for the students, and the attendance of the chemical laboratory, which was fitted for 12 students, was optional. There was a lecture assistant and a laboratory boy. For these duties Colonel Chesney did not appear to think that the salary I received (600*l.* a year, a house, and an allowance of 35*l.* a year for coals and gas) excessive, for when the telegraph students were admitted to the College, he obtained for me an additional 60*l.* a year. About the year 1883 the Board of Visitors decided that the chemical laboratory should be enlarged, and that all the students should attend it, and that the work should be continued in the third year by students who showed special aptitude for the subject; a demonstrator, Dr. Matthews, was appointed to assist in the laboratory teaching. At the same time the physical laboratory was built, and a professor and demonstrator in physics were appointed; this relieved me of the instruction of the telegraph students. When the analytical laboratory was instituted, Sir Alexander Taylor obtained for me an additional 50*l.* a year for superintending it. I mention these facts as an explanation of Colonel Ottley's remarks about the teaching of chemistry in his report (p. 27). Colonel Chesney desired to make Cooper's Hill a working college, and, to attract the best teachers he could obtain, he proposed to have a well-paid staff who were entitled to pensions. Another arrangement that he made was that each lecturer should have one free day in each week. Of recent years these arrangements have been seriously modified.

Perhaps I may mention that since 1872 we have carried on at the College a nearly complete set of meteorological observations taken twice daily, the monthly reports of which have been regularly sent by me to the Meteorological Office, with the exception of one month when the instruments were sent to Kew to be verified. In this period there have been only a few days when the observations have been omitted, and I have divided the vacation with my assistants so that there should be no break of continuity.

It should be noted that the table on p. 35 stating the times of actual teaching spent by the members of the staff gives a very inadequate idea of the work they have to do, especially in the case of those who give experimental lectures.

The effects of the proposed changes to myself personally are very painful. After serving the Crown for 41 years (11 as assistant chemist to the Royal School of Mines before my appointment at Cooper's Hill), I cannot but feel grieved at the dismissal which I received in such a sudden and unexpected manner. I hoped that my work had been appreciated, but it appears to be otherwise. The dismissal of myself and my colleagues seems to imply inefficiency or a refusal to adapt ourselves to the new curriculum, of which, however, we were absolutely ignorant until the publication of the Blue Book. This is the impression that was first produced on many who did not know the working

of the College, although I am happy to think that recent events have shown that this impression has been removed. In any case a treatment of this kind, and at an age when one is not likely to be able to obtain a similar appointment and with a pension rather less than I should have expected if I had voluntarily retired at the end of the session, must fall very heavily on oneself and one's family.

HERBERT MCLEOD.

APPENDIX 6.

STATEMENT of Professor T. A. HEARSON relating to his dismissal from Cooper's Hill College.

Observing that the College was in a more flourishing condition than it had ever been in the whole course of its existence, as indicated by the steadily increasing number of applications by eligible students for entry, by the increasing demand for our qualified students to occupy important and lucrative appointments, and by the attainment on the right side of a balance between receipts and expenditure, the notice of my dismissal came with a great shock of surprise.

I have recently had a special opportunity as Examiner in the Mechanical Sciences Tripos for the University of Cambridge for the last two years of comparing the results which we obtain with those produced at the Engineering School which has the highest reputation in the country, and having reason to be gratified by the comparison, I felt that at Cooper's Hill we were working on sound lines.

Believing that I never was more capable of doing the work which I was appointed to do than now, and that there is work in other subjects of applied mechanics which I had specially fitted myself to teach, and which I had asked to be allowed to undertake, I submit that to dismiss me in this manner after more than 16 years of loyal service is not only an act of great injustice to me, but is inimical to the best interests of the College.

The reason alleged for the retirement of Mr. Heath and myself, page 41, is to effect a saving of 835*l.* a year. In addition to this reason, Colonel Ottley, on page 24, adds that, in his judgment, the work would be done better by Dr. Brightmore and an assistant at 450*l.* a year, and remarks that my appointment (which was made nearly 17 years ago) debars Dr. Brightmore (who has only recently been appointed) from teaching his strongest subject.

The fact that Mr. Heath has, since the retirement of General Courtney more than two years ago, been an instructor in surveying, appears not to have been placed before the Board of Visitors. This so much modifies the amount of the saving that, when taken into conjunction with the pensions which are allowed, it causes the annual saving to be a negative quantity, thus:—

Annual Expenditure.

At present.	£	*s.*	*d.*		*Sanctioned New Scheme.*	£	*s.*	*d.*	
Mr. Heath - -	485	0	0	and house.	Dr. Brightmore -	600	0	0	and house.
Professor Hearson -	600	0	0	and house.	His Assistant - -	450	0	0	
Mr. Woods - -	350	0	0		Survey Instructor -	350	0	0	
Dr. Brightmore -	600	0	0	and 100*l.* house allowance.	Mr. Heath's pension -	273	9	9	
					Professor Hearson's pension - -	150	0	0	
	2,135	0	0	and two houses.		2,273	9	9	and house.

If a house is valued at 100*l.* per annum, the annual loss will be 38*l.* 9*s.* 9*d.*

Thus Colonel Ottley's first reason for my dismissal falls to the ground.

I would here quote an extract from a letter written me by Colonel Ottley on 16th January:—

> "I am anxious also to assure you that in determining your appointment there has, I believe, been no hint whatever that any fault has been found with the efficiency of your teaching. The change has been made for purely economical reasons."

Referring next to the further reason adduced by Colonel Ottley, and to his remark that Dr. Brightmore is debarred from teaching his strongest

subject, hydraulics, I beg to lay before the Board of Visitors the following facts.

Before the arrival of Colonel Ottley I approached Dr. Brightmore immediately on his appointment, with a view to effecting an interchange in some of the subjects of instruction.

Having the charge of the mechanical laboratory and the practical instruction in the strength and elasticity of materials, I was desirous of taking over the lecture work portion of that subject, to which I had devoted considerable attention in my previous appointment at the Royal Naval College, in order that the mechanical laboratory course may be fitted into, instead of being merely added on to the theoretical portion of the subject. I at the same time recognised that probably Dr. Brightmore would be more at home in giving instruction in water-supply constructions, and thought it desirable that the students should have the benefit of such special knowledge.

Dr. Brightmore freely responded, and when Colonel Ottley arrived he was asked by both of us to sanction the change.

At first he demurred, saying he would like to have time to consider the matter, and when he was afterwards pressed by both of us to allow the exchange he refused.

I have therefore also been debarred from teaching one of my strongest subjects.

That the work would be done better if the change were made I deny entirely.

I must resolutely insist that if the reputation of Cooper's Hill is to be maintained the subject of applied mechanics should have an honoured place in the curriculum, and, in order to encourage the students to apply themselves to this difficult subject, it should be paid for liberally in marks, and definite qualification in the group of subjects of which it consists should be insisted on, by retaining them in a separate branch.

Moreover, these subjects should be taught by qualified engineers, and not by mathematicians, as is feebly attempted at the Royal Military Academy, Woolwich. Sir George Chesney realised the importance of this portion of an engineering education when he made his early appointments, and the reputation which Cooper's Hill men have achieved is largely due to their early training in these subjects.

It now comprises a large portion of the instruction at every engineering college, and the syllabus of the examination for qualification as Associate Member of the Institute of Civil Engineers consists almost entirely of it.

Mr. Benton is well known for his proficiency in applied mechanics, and there is not the slightest doubt that he had this in his mind as a "professional subject" when he wrote what is quoted on page 34, and yet he is cited as an authority for the new curriculum in which the subject is not known by name and will probably be thrust out by less worthy rival subjects.

I put forward a copy* of the proposed timetable of Colonel Ottley, in which are inserted only the subjects which are entrusted to Dr. Brightmore; those in ordinary type are required to be personally provided for by Dr. Brightmore with his tutorial assistant.

* Addendum 2.

I submit that this is such an unreasonable amount of work, and should extend over such a large range of subjects, that it cannot be expected to be satisfactorily performed. Whether or not this opinion is shared by others, I would point out that it is excessive as compared with the duty expected of other members of the staff equally well paid.

Considering that so many subjects have to be taught in a limited time, I have no hesitation in condemning an extension of the obligatory workshop course.

Instruction in carpentry was tried in Sir George Chesney's time, and, after experience, was abandoned on the advice of General Hyde, Consulting Engineer for the Indian State Railways.

With the provision of more apparatus and an enlarged or an additional mechanical laboratory now under construction, the mechanical laboratory course could be extended with very great advantage and made to include experimental observations in hydraulics.

With reference to the proposal to transfer the machinery of the mechanical laboratory, including the testing machine, to the new building, I append a letter* which I addressed to the President on 17th December 1900, before I had received notice of dismissal.

* Addendum 1.

The proposal to remove private study time from the third year, and require the designs to be carried out under the immediate eye of the responsible professor or instructor, will result in the elimination of all initiation and individual effort on the part of the student. The students will wait for the instructor to work out the designs for them, and the teaching will naturally degenerate into spoon-feeding of the most babyish character.

If a comparison is made between Cooper's Hill and Woolwich or Sandhurst respecting private study time, not only should the question of the purpose for which it is given at Cooper's Hill and the lack of purpose at Woolwich and Sandhurst be taken into account, but also the difference of age of the students in these Colleges. Those at Cooper's Hill in their third year are from 21 to 23 years of age. Those at Woolwich and Sandhurst are about two or three years younger.

The advantages of the present method, which was instituted by Sir George Chesney, have been proved by years of experience. There are, no doubt, abuses of the liberty it offers, but the advantages far outweigh the disadvantages.

The alternative method, which is plotted in the proposed third year time table, of about 1½ hours only at a time, under the eye of the instructor, involving bringing large drawing boards out and instruments, will result in a waste of effort.

The work requires and is now done during many hours at a stretch, and a great deal in the evening.

This will apparently be precluded, to the detriment of the hard workers.

Addendum 1 to Statement put in by Professor Hearson.

Letter from Professor Hearson to Colonel Ottley.

Mechanical Laboratory, Cooper's Hill,
17th December 1900.

Sir,

Before the machinery of the mechanical laboratory is put out of working order for the purpose of being re-erected in the new building, which has been planned to receive it, it will be necessary that due notice is given to Sir Alexander Rendel and the Director-General of Stores, that between certain dates we shall be unable to undertake any mechanical testing work.

Whilst writing to ask for instructions respecting this, I feel it my duty to point out certain costs and difficulties which the removal of the laboratory will entail, to which your attention may not have been directed.

I understood in conversation with you that you have designed to use the present mechanical laboratory as an electrical laboratory, and for that purpose propose to retain the engine and shafting in place, and drive the machinery of the new mechanical laboratory by means of the workshop engine.

As a first objection to this scheme, I would submit that you will probably find that the laboratory engine is too light to drive electrical machines with sufficient steadiness to get a satisfactory result. The workshop engine was provided with specially heavy fly-wheels and double governing contrivances, for the purpose of eliminating fluctuations of speed as far as possible.

Secondly, because the workshop engine is a larger and more powerful engine, you will probably find that the cost of running it for the duty of the mechanical laboratory alone, which the conditions of the work to be done will often necessitate, will outweigh any saving which would be effected during the hours when the mechanical laboratory and workshop are running simultaneously.

I estimate the normal expenditure of gas in the mechanical laboratory engine at 100 cubic feet per hour, and in the workshop engine at 180 cubic feet per hour.

There are about 30 weeks in the year during which the workshop engine is in operation in the afternoon, whilst during the mornings it would generally be at rest, asfar as workshop purposes are concerned. If the mechanical laboratory is driven by the same engine, it will be necessary to run it for from two to three hours each morning in addition; taking a mean of $2\frac{1}{2}$ hours per morning for six days a week for 30 weeks, we require 150 extra hours of work. Also, there are about 20 weeks of vacation and examinations, during nearly the whole of which the engine would, for workshop purposes, be at rest. Supposing for the purpose of the mechanical laboratory it is required to run for five hours a day on the average, then $5 \times 6 \times 20 = 600$ more hours of work are requisite, making a total of 1,050 hours at 180 cubic feet per hour = 189,000 cubic feet of gas.

To this should be added a small quantity to allow for extra expenditure when workshop and laboratory are going together, say 10,000 more, making a total expenditure of 200,000 cubic feet. Under the present circumstances we are able to run the mechanical laboratory at the cost in gas of 5 hours $\times$ 300 days $\times$ 100 cubic feet per hour = 150,000 cubic feet.

Therefore, no economy of gas appears to be possible from the change, but the contrary.

With respect to the new foundations for the testing machine, I would direct your attention to the great recoil which occurs on the fracture of a piece of metal under a heavy load. This puts a very severe strain on the foundations of the testing machine, and not a little responsibility is attached to making the proposed change, for if we become liable to the breakdown of our testing machine, we risk a considerable loss of income. To satisfy the requirements of the India Office, we have to be very prompt with our tests.

The immunity against breakdown which we have hitherto enjoyed has, I think, been largely due to the liberal and costly foundations to which the testing machine is now secured.

If the mechanical laboratory were left where it is, and the new building were used for an extension of the electrical machinery, there would probably be sufficient room left for additional apparatus for other laboratory experiments, including hydraulic experiments. The saving of the cost of removal and loss of income would probably go a long way towards providing the necessary apparatus.

I am, Sir,
Your obedient Servant,
T. A. Hearson.

The President.

Addendum 2 to Statement put in by Professor Hearson.

TIMETABLE.

Engineering.
Designs.
Mechanical Laboratory.
Workshops.

		Winter. 1st Year.	Winter. 2nd Year.	Winter. 3rd Year.	Summer. 1st Year.	Summer. 2nd Year.	Summer. 3rd Year.
Monday	8.30—10			*Workshops* (½ *Year*). | Mech. Lab. (½ Year). | Designs (½ Year.)			*Workshops* (½ *Year*). | Mech. Lab. (½ Year). | Designs (½ Year).
	10.10—11.10	Engineering.			Engineering (½ Year).		
	11.20—12.20		Engineering (½ Year).			Engineering.	
	1—2	*Workshops* (½ *Year*).		*Surveying* (½ *Year*). Engineering, including Designs.	*Surveying* (½ *Year*). 10.10—4.	*Workshops* (½ *Year*). | Mech. Lab. (½ Year).	Engineering and Designs.
	2.10—3		Engineering Design (½ Year).				
	3—4						
Tuesday	8.30—10			*Workshops* (½ *Year*). | Mech. Lab. (½ Year). | Designs (½ Year).			*Workshops* (½ *Year*). | Mech. Lab. (½ Year). | Designs (½ Year).
	10.10—11.10	Engineering.			Engineering (½ Year).		
	11.20—12.20		Engineering (½ Year).			Engineering.	
	1—2	*Workshops* (½ *Year*).		*Surveying* (½ *Year*). Engineering, including Designs.	*Surveying* (½ *Year*) 10.10—4.	*Workshops* (½ *Year*). | Mech. Lab (½ Year).	Engineering and Designs.
	2.10—3		Engineering Design (½ Year).				
	3—4						
Wednesday	8.30—10			Designs.			8.45 to 10 Designs.
	10.10—11.10	Engineering.			Engineering.		
	11.20—12.20		Engineering.			Engineering.	
	1—2			Engineering.		6 *Lectures* { *Metallurgy.* *Iron and Steel.*	Designs.
Thursday	8.30—10			*Workshops* (½ *Year*). | Mech. Lab. (½ Year). | Designs (½ Year).			*Workshops* (½ *Year*). | Mech. Lab. (½ Year). | Designs (½ Year).
	10.10—11.10	Engineering.			Engineering (½ Year).		
	11.20—12.20		Engineering (½ Year).			Engineering.	
	1—2	*Workshops* (½ *Year*).		*Surveying* (½ *Year*). Engineering, including Designs.	*Surveying* (½ *Year*). 10.10—4.	*Workshops* (½ *Year*). | Mech. Lab. (½ Year).	Engineering and Designs.
	2.10—3		Engineering Design (½ Year).				
	3—4						
Friday	8.30—10			*Workshops* (½ *Year*). | Mech. Lab. (½ Year). | Designs (½ Year).			*Workshops* (½ *Year*). | Mech. Lab. (½ Year). | Designs (½ Year).
	10.10—11.10				Engineering (½ Year).		
	11.20—12.20		Engineering (½ Year).			Engineering.	
	1—2	*Workshops* (½ *Year*).		*Surveying* (½ *Year*). Engineering, including Designs.	*Surveying* (½ *Year*). 10.10—4.	*Workshops* (½ *Year*) | Mech. Lab. (½ Year).	Engineering and Designs.
	2.10—3		Engineering Design (½ Year).				
	3—4						
Saturday	8.30—9.40			Designs.			Designs.
	9.50—10.50				Engineering.		
	11—12		Engineering.			Engineering.	

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N.B.—This timetable is to be worked by one Professor with a Tutorial Assistant, except as regards Workshops and Surveying.
The Designing time is broken up into short intervals, many of which are so short as to be practically useless. The Drawing boards cannot be left, as the room is wanted for other men in between. At present they work in their rooms (in 3rd Year) and can put in a great deal of continuous time. They get help when required, but do a good deal on their own initiative, which would hardly be the case if they have a Professor always at their elbows.
It seems strange to put Workshops in the cream of the morning (8.30—10) to be followed by Lectures immediately afterwards. (See 3rd Year.)

Addendum 3 to Statement handed in by Professor Hearson.

Extract from Speech by General Sir Alexander Taylor, G.C.B., President of the College, at Cooper's Hill, 27th July 1894.

They completed that day their twenty-third session. They looked back on twenty-three years of hard work, and, what was more to the point, on twenty-three years of successful work. No one questioned the great measure of success that had been achieved, a success that reflected so much credit on the staff of the College. He had lately read a pleasant piece of unexpected praise, which, if he quoted, he might be pardoned. It occurred in a recent number of one of our leading professional journals, in which the writer stated his opinion, "that the railways of India afford a striking testimony to the "ability of the engineers of the Public Works Department, men little known "to the British public, but who for ability, integrity, and devotion to duty, "form a body than which there is no finer in the service of any Government "in the world. The fact of being able to obtain such service in all depart-"ments is what renders the Government of India possible, and is a matter "for honest pride to the British race."

Of course, these were only the views of the writer, but those who know what English officers do in India would, he was sure, share and accept them. It was also the case that the Public Works Department was not wholly composed of engineers supplied from Cooper's Hill, but, on the other hand, they had largely recruited it for over twenty years, and were entitled to their share of the very high praise which the writer gave, and rightly gave, to the officers of the Public Works Department. From the members of the staff of the College, he had received during the year that had now closed, the same cordial, loyal assistance that they had always given him. He heartily thanked them for their good help in so many different directions, and to emphasise his sense of their devoted and successful work.

Extract from Speech by Lord Reay at Cooper's Hill, 27th July 1894.

Lord Reay, speaking of Cooper's Hill said, "That Institution had already, "although its career was quite short, provided India with many very able "men. For instance, he might mention the names of Mr. Finney (new "manager of the Eastern Bengal State Railway), Mr. Lionel Jacob (traffic "manager of the North-West, and temporarily in charge of a class at Cooper's "Hill), Mr. F. B. Hebbert (Under Secretary to the Government of India), "Mr. Wynne (agent and manager of the Bengal Nagpur Railway), Mr. Rose, "C.I.E. (constructor of the Khojak tunnel), and others."

Extracts from Speech by General Sir Alexander Taylor, G.C.B., President of the College, at Cooper's Hill, 31st July 1896.

My Lord,—We complete to-day our twenty-fifth session. I may safely say that they have been years of earnest work to all concerned; to many they have been years of hard work, and to the question, "What is the result?" the answer is, "A satisfactory amount of success." As far as I have the means of judging, I am satisfied that this is the answer that would be given by the Government of India and by the Departments in India in which our men have served. From papers touching this subject that have recently passed through my hands, I have selected two to refer to to-day, partly because the opinions expressed in them are the opinions of very competent men in the Public Works Department of India, men who have had quite special opportunities of forming reliable opinions, and who, at the time of writing, held high appointments in the Department; and partly also because their opinions are expressed with no uncertain voice,

One officer stated his view in this shape. He said that the person of whom he was writing, "had acquired the reputation of being one of the very best of officers who ever came from Cooper's Hill," and, he added, "higher praise than this is impossible."

Then on the opening of the Periyar Waterworks, in the Madras Presidency, the head of the Public Works Department was able to say that, in his opinion, "the administrative history of India shows nothing equal to the "devotion of the Civil Engineers of the Public Works Department, and "especially of the Cooper's Hill engineers, under circumstances that "would have damped the energies of less devoted men. Nothing had "succeeded in weakening one iota of their devotion to their Government." These are the opinions of two experienced officers of the Royal Engineers, officers high in the service, and at the time of writing in no way connected with Cooper's Hill." . . . .

"My Lord, on many occasions in past years I have had opportunities of thanking the members of the staff of the College for their good work, and for the invaluable help they have given me in so many ways. In no sense nor in any respect has there been any falling off during the current year, and my hearty thanks are due to every one of them." . . . .

"As I have already said, I have on past occasions repeatedly expressed in the presence of you gentlemen who compose the staff of the College, my warm appreciation of your excellent work, and I desire to-day to emphasise all I have said on those occasions. I have found it a pleasure to work with you. I heartily acknowledge that the results that have attended our endeavours during all these years have been mainly due to you, and I entirely wish you to get the very full share of the credit that is so eminently your due."

Sir A. Taylor then referred to some members of the staff with whom he had been brought into special and prolonged personal relations, whom he desired specially to mention and to thank, viz., Professor Reilly, the bursar (Mr. Pascoe), Dr. Schlich, of the Forestry Branch, General Courtney, Mr. Heath, Professor Hearson, and Mr. Hicks, for the work they have done. It had abounded in good results.

EXTRACTS from Speech by the Right Honourable Lord George Hamilton, Secretary of State for India, at Cooper's Hill, 31st July 1896.

Lord George Hamilton said that he remembered that the last occasion upon which he was present was twenty-two years ago. The College was then in its infancy, and there were many who looked askance at its establishment as well as its aspirations. But the report read, clearly established the fact that the Institution had more than justified its establishment and its existence. . . . . At the time the College was founded they were face to face in India with a very grave financial difficulty; it was hardly possible to balance the expenditure or meet it out of ordinary revenue. It was clear that there were immense latent capacities in India, and that its powers of production were almost unlimited, but it was clear that these could only be developed by a large system of public works. It was necessary in the then condition of Indian finance that these works should not only be productive, but be remunerative. At that time there was an idea that nothing could be done by Government, and that everything of that kind must be carried out by private enterprise. After some discussion the Indian Government took a different view; they knew that private enterprise, in the ordinary sense of that term, did not exist in India, but the Government wisely thought that, if these works had to be undertaken, they might dispense with the middle man, and take a large proportion of the labour upon themselves. It was with this view that Cooper's Hill College was founded, in order that year by year, a sufficient number of highly trained young men might go out and develop that policy. It was gratifying that the experiment had answered so well. There was no part of the expenditure of India that gave a better return than the outlay upon public works, and not only were the direct benefits greater, but the indirect benefits were incalculable, and it was largely due to the

enterprise and training of the officers of the Public Works Department that Indian finance was gradually assuming a more satisfactory aspect. Students of that College did not go out as unknown individuals, but as units in a great, perhaps the greatest, administrative and most perfect executive machine that the world has ever seen. . . . .

Then he went on to speak of Sir Alexander Taylor, saying, he went there at a period when a great change was made in the character of the Institution, and he congratulated him upon the extraordinary result, that, with scarcely an exception, he had obtained appointments for his students when they had failed to obtain positions in the Public Works Department in India.

EXTRACT from Speech by Colonel Pennycuick, President of the College, at Cooper's Hill, 28th July 1899.

"An abstract of the reports of the examiners has been submitted to the Secretary of State; the quality of the work continues to be fairly up to the high standard of former years. The educational staff has been short-handed throughout the year, owing to no successor having been appointed to Major-General Courtney, who retired at the close of the last session, and the greatest credit is due to its members, and especially to Messrs. Heath and Woods, for the manner in which the instruction has been carried on during this period."

EXTRACTS from Speech by the late Field-Marshal Sir Donald Stewart, at Cooper's Hill, 28th July 1899.

He gathered from the report Colonel Pennycuick had just read that the success of the College had been fully maintained in the past session, and he was very glad to hear from the President that most of those leaving the College had secured employment either in the public service or elsewhere. There could be no better test than that of the good work done in the College . . . .

Their thanks were due to Colonel Pennycuick and the teaching staff of the Institution.

EXTRACT from Speech by Colonel Ottley, President of the College, at Cooper's Hill, 27th July 1900.

The fifteen gentlemen who have this year been commissioned direct from Cooper's Hill were worthily maintaining the credit of their old College. Indeed, short as their service has been, some of them had already been selected by their commanding officers for active service in the field. Colonel Ottley was not surprised that the ex-students should develop into good soldiers, because during the Tirah campaign he happened to have under his orders two old Cooperzillians, Fowler and Halliday, of the Royal Engineers, and was thus able to satisfy himself at first hand on active service that the material turned out by this College is really of most excellent quality.

APPENDIX 7.

Statement filed by Mr. Heath.

Mr. A. H. Heath was appointed in August, 1875, as an Assistant Professor of Engineering, working with Professors Reilly and Unwin as colleagues, each taking a definite and distinct part of the course of teaching. (Mr. Heath had been acting as examiner of the third-year students on the results of their practical course in July, 1875.)

Mr. Heath served under Colonel Chesney, Sir A. Taylor, and Colonel Pennycuick, all of whom expressed publicly and privately their high appreciation of his services.

On the retirement of Major-General Courtney from the post of Professor of Surveying in July 1898, Colonel Pennycuick requested Mr. Heath to take charge of the Survey course, which was carried out by Mr. Heath solely, without assistance, during the Session 1898–99, Mr. Heath's former work being taken partly by Mr. Woods and partly by Colonel Pennycuick, with the exception of the Railway Station design.

In September 1899, in consequence of the appointment of Dr. Brightmore as Professor of *Engineering* and *Surveying*, Mr. Heath was told by the President (Colonel J. W. Ottley) that the orders of the India Office were that Mr. Heath was to be placed in a subordinate position under Dr. Brightmore. Mr. Heath made a formal protest against this alteration in his position, but his protest was disregarded by the India Office.

Mr. Heath considered that this alteration in his status in the College was a breach of his letter of appointment, and an injury to him. He had not been appointed an Assistant *to* the Professor of Engineering, but as a colleague of the then two Professors of Engineering and Applied Mechanics. The late President, Colonel Pennycuick, fully endorsed this statement of fact at the time of Dr. Brightmore's appointment.

At Christmas 1899, Dr. Brightmore, finding that he was unable to carry on any survey work in addition to his work as Professor of Engineering, requested that Mr. Heath might take up his (Dr. Brightmore's) survey work, and under the orders of the President, Mr. Heath took over the survey course, with the assistance of Mr. R. J. Woods, who had been Instructor under General Courtney in 1898.

In September 1900, Mr. Heath was requested on the opening day of Session (1900–01) to prepare for and carry out the usual third-year Project course, which he did for the six weeks of the course, a temporary substitute meanwhile being provided to take up the Survey course Mr. Heath resumed the Survey course in November. At present he is giving lectures and preparing for the Railway Station design in the third-year course, in addition to the usual Survey course.

Instruction in Canal and Railway Construction, page 21, *Blue Book.*

Railway construction has always been included in Mr. Heath's Descriptive Engineering courses, as regards railway reconnaissance and location, setting out, earthwork (practical execution and measurement) and the provision of works of art, areas of land required, a complete course of typical foundation and constructional works; railway economics, *i.e.*, cost of construction, &c., cost of working, gross loads, dead loads, and paying loads, influence of gradients and curves; railway permanent-way, both compound and wholly metallic; permanent-way fittings; the planning of railway stations with necessary sidings, goods yard, locomotive yard, &c., signalling and locking arrangements as far as can be taught in a college course. The students make a design of a railway station under Mr. Heath's supervision.

Mr. Heath's experience of railway work consists of 10 years' service on the Great Northern Railway, and he has made constant study of the subject.

Canal and reservoir engineering is partly dealt with in Mr. Heath's lectures on earthwork, and more fully by Professor Hearson.

Mr. Heath has not been consulted as to alleged deficiency of instruction, nor as to any new scheme of instruction, except as stated below. Mr. Heath had no knowledge of the Board of Visitors' opinion, as stated in the Blue Book on page 21.

Colonel Pennycuick's Letter, page 21.

"No member of the existing staff is competent to give the *exact* instruction required."

This is now stated by Colonel Pennycuick to refer to details of railway construction and management peculiar to India, and to be a course of lectures entirely extra to Mr. Heath's course. This extra course was suggested to the India Office by Colonel Pennycuick, to be given by Mr. J. Bell, but was not adopted.

Mr. Heath was consulted as to the teaching of details of locking apparatus and signalling, and he reported that with models he could give such a course, but models are very expensive, and soon become obsolete, and he recommended instead a three months' course of study on one of our best railways, after the College course had finished, for a few selected students. This suggestion was approved by the President and the Secretary of State, and has been adopted and carried out last October 1900. (Report made at end of 1899 or beginning of 1900.)

"The present system antiquated, illogical, and out of date." Precise meaning doubtful. No such opinion stated to me by the President, no consultation or inquiry as to my work.

Statement denied.

"*Times of Actual Teaching*," *page* 35, *also page* 23.

The statement as to Mr. Heath's time of actual teaching is incomplete as to Mr. Heath's work.

An exceptional and solitary case is taken in the Summer Term statement, when the President (Colonel Pennycuick, R.E.) took some of Mr. Heath's lecture hours.

A more correct average lecture hour statement would be:—

Summer term, 4·5 hours.
Autumn term, 6·0 hours.
Easter term, 4·4 hours.

Giving an average of 4·9 (4·83) hours, instead of 3·6 hours.

These are all oral lectures requiring a considerable amount of preparation, and differ materially from hours of class-room work or of laboratory work.

But this statement omits altogether the supervision and giving instruction on the third-year Project course, lasting six weeks, and for half of that time requiring Mr. Heath's services for at least nine hours per day, and for the rest of the time his attendance for consultation for, say, four to six hours per day.

The railway station design occupies one week, with attendance for consultation for, say, six to eight hours per day. The arranging of visits to iron and steel works and to brickfields, and assigning marks for competition of the notes and reports made by the students, is not considered in this statement, nor the assignment of marks for the Project course drawings, &c., for which Mr. Heath has been compelled to adopt a lengthy, careful examination into the accuracy of details.

Mr. Heath has also had charge of the system of arrangement, distribution, and compilation of the student's marks, entailing the expenditure of much time, consideration, and labour.

There are also written examinations every term, which require an exceptional amount of time to read and value for marking in competition.

As Mr. Heath gave lectures on several progressive subjects, such as manufacture and manipulation of iron and steel, manufacture and use of limes and cements, new methods and systems of engineering construction, &c., new methods of railway work, a large amount of time has been necessarily spent in remodelling, adding to, and rewriting the oral lectures.

As Mr. Heath has been publicly thanked for his services to the College on several occasions during the last 25 years, there can be no doubt these services have been ample and have been efficiently performed.

There are so many details of College work on which Mr. Heath has been employed from time to time, that it is not a simple matter to give an accurate and complete account of his work, but a fair estimate, made for the President in 1892 and 1895, gives 30 to 35 hours per week. Mr. Heath has had, in addition to the purely teaching work, a large amount of work in connection with the College recreative clubs, being President of (1) the cricket, (2) the lawn tennis, (3) the Rugby football, (4) the Association football, (5) the athletic sports clubs, and also member of committee of the boat club. This entails the expenditure of a considerable amount of time, thought, and work.

Surveying.

The time allotted to surveying was reduced by the College Board about 1896 to make room for other subjects deemed more important.

The staff attached to the survey course was reduced from two to one on the retirement of General Courtney in 1898; Mr. R. J. Woods, who had been instructor under General Courtney, taking up the teaching of applied mechanics, and Mr. Heath taking sole charge of the survey course for the session of 1898–99. Mr. Heath, by organisation of the class of about 20 students into small parties, did not find any difficulty in arranging the course satisfactorily, and he was publicly thanked by the then President for his services in this respect.

Mr. Heath's experience of nearly 26 years has taught him that the best way of educating, *i.e.*, of drawing out and expanding the mind, is to make the student think for himself, to place upon the student the responsibility for the work done; and the more fully this system is carried out, the better will be the product. He does not agree with the President (Colonel J. W. Ottley) in the system which appears to meet his approbation, viz., of class-room work always under supervision, with ready access to a teacher at the slightest sign of a difficulty, and considers such system of spoon-feeding to be demoralising and detrimental to the growth of the thinking faculties. The acquisition of skill in surveying is largely a matter of extended practice and experience.

Private Study.

Mr. Heath's opinion is that a student must be allowed time for the digestion and assimilation of lecture work, and for the growth of a feeling of personal responsibility for work.

Work which is carried out always under supervision and direction, will tend to develop a machine always requiring an impulse from without to set it in motion. General Sir A. Taylor, late President, used to give an excellent illustration of this system. A young Royal Engineer officer in India received orders to build a temporary bridge across a stream at a fixed hour. At the time named the officer was at his post, but there were no bridging materials on the ground, and his explanation was that the materials, according to his experience, always had been provided and brought on the ground by someone else.

Personal responsibility and freedom from constant supervision tend to develop the active minded responsible man, accustomed to employ forethought, and to reason from cause to result in observed facts, to search out remedial or preventive measures, and to do his duty to the best of his powers.

Such a system of private study may be abused in a few cases, but that is far from being the case with the majority of the Cooper's Hill students.

The constant supervision system cannot extract from a student more work than he willingly produces.

It appears to Mr. Heath to be essential that the Cooper's Hill student for service in India should be trained to be a responsible *man* in the best sense of the words.

APPENDIX 8.

TABULAR STATEMENT handed in by Professor MINCHIN.

Time allotted to Lectures and Private Study respectively during a portion of the Session 1877–78.

Session 1877–78. Autumn Term and First Half of Easter Term. (Sir G. Chesney's Time.)

Senior Students.

Day.	No. of Lecture.	I. Division.		J. Division.		Up to 3 o'clock.
		Subject.	Room.	Subject.	Room.	
MONDAY -	I.	M.E.	Thea.	M.E.	Thea.	Lectures - - 3 hours.
	II.	P.S.		P.S.		Private study - 3 „
	III.	Accts.	Thea.	Accts.	Thea.	
	IV.	P.S.		P.S.		
TUESDAY -	I.	P.S.		P.S.		Lectures - - 0 hours.
	II.	P.S.		P.S.		Private study - 6 „
	III.	P.S.		P.S.		
	IV.	P.S.		P.S.		
WEDNESDAY -	I.	E.	Thea.	E.	Thea.	Lectures - - 3 hours.
	II.	P.S.		P.S.		Private study - 3 „
	III.	Accts.	Thea.	Accts.	Thea.	
	IV.	P.S.		P.S.		
THURSDAY -	I.	P.S.		P.S.		Lectures - - 1½ hours.
	II.	M.E.	Thea.	M.E.	Thea.	Private study - 4½ „
	III.	P.S.		P.S.		
	IV.	P.S.		P.S.		
FRIDAY -	I.	E.	Thea.	E.	Thea.	Lectures - - 1½ hours.
	II.	P.S.		P.S.		Private study - 4½ „
	III.	P.S.		P.S.		
	IV.	P.S.		P.S.		
SATURDAY -	I.	E.	Thea.	E.	Thea.	Lectures - - 1½ hours.
	II.	P.S.		P.S.		Private study - 2½ „
						Total hours of lecture 10½
						„ „ P.S. = 23½

APPENDIX 9.

Statement handed in by Professor Lodge.

Entrance Examination.

The standard has gradually risen during the last three or four years. We agreed with the President that with the increased number of appointments now able to be offered to successful students it might be possible to add additional subjects to the entrance examination, and attract a higher stamp of candidate provided the change were well advertised.

It is greatly to be feared that the present disaster to the College will keep many candidates away, particularly those that we had hoped to attract.

Pure Mathematics.

I feel strongly that instead of this subject being continued into the third year, more time should be given to it in the first year. At least four lectures a week are required in the first year, some of which should be divisional. In the second year three lectures a week are sufficient, and it is not so important to have any of them divisional. I get a good many of the students to work in pairs, so as to diminish very considerably the time needed to go round the class.

With one or two divisional lectures in the first year, I do not want a tutorial assistant. It would be a needless expense. In fact the new scheme aims at cumbering mathematics and starving engineering and physical and chemical science.

It would be easy to provide more mathematical time in the first year by diminishing the amount of engineering and physics given in that year, particularly in the autumn term. I mention these subjects because students cannot make satisfactory progress in them until they have a fair amount of mathematical knowledge. In fact, the first year should be considered as the year in which the foundations are laid on which the rest of the course is to rest, and mathematics is a very important part of the foundations.

The proposed qualifying minimum would be absolutely disastrous. Many able men would be disqualified, and the financial result would be a heavy deficit, as men would not come to a college where such an impossible standard was exacted. The satisfactory return of our present standard is shown by the fact that all those students who qualify obtain good appointments.

If the standard is insisted on, it will be impossible to adequately teach the higher mathematics, we must keep to easy work. The teaching would be consequently less efficient under the weight of the excessive percentage required.

If it is found that the attractions of the Service are sufficient to attract a greater number of able men, we might by degrees be able to raise the qualifying standard, but even then it would probably be better to do this by setting harder papers than by raising the percentage required. All the men will never be mathematicians, and yet they may be very useful public servants by efficient knowledge in other directions, provided their mathematics reaches a *reasonable* standard.

Telegraph Students.

The mathematical attainments of Telegraph Students would be much greater if they were chosen at the end of their second year's course, and then trained for their special work during their third year. A fairly high mathematical standard might be exacted from them, if the attractions of the Service were made good enough to induce the better men to take this work. Latterly the attainments of the Telegraph Students has been exceedingly low. This year there is however a great improvement. The mathematical

staff used to assist in selecting the Telegraph Students, but for the last three or four years the selection has been entirely in the President's hands. Of course much power of selection is not possible so long as good men will not apply, and the India Office are unwilling to wait for properly qualified men. In some cases they have actually accepted men who have not qualified.

APPENDIX 10.

Correspondence on Professor Hearson's Proposals for re-organising Engineering Staff at Cooper's Hill.

(1.)

Professor Hearson to Colonel Pennycuick.

Royal Indian Engineering College,
Cooper's Hill,
29th March 1899.

Sir,

I understand you are about to vacate the appointment you now hold as Professor of Engineering Construction.

In view of this I beg to submit through you, for the favourable consideration of the Secretary of State for India, the following scheme for providing at Cooper's Hill the required instruction in Engineering, which comes under the following heads, viz. :—

Applied Mechanics, including the theory of the strength and elasticity of materials and structures, Hydraulics, Theory of Machines and Thermo-Dynamics.
Descriptive Engineering.
Surveying.
Bridge Design.
Mechanical Design.
Project Work; and
The control of the Mechanical Laboratory and Workshop.

That for this purpose there be appointed the following Members of Staff:—

(1.) A Senior Professor of Engineering at a salary of 700*l.* per annum.
(2.) A Professor of Engineering at a salary commencing at 500*l.* and rising to 600*l.*
(3.) An Assistant at a salary commencing at 400*l.* and rising to 500*l.*
(4.) A Second Assistant at a salary commencing at 300*l.*, and rising to 400*l.*

That all the subjects above enumerated be treated as a homogeneous whole, and that the Senior Professor of Engineering be responsible for providing, by himself and the other three members, for all the instruction in those subjects, the President's approval being obtained of the arrangements he may make. Previously these subjects have been taught by five members of the Staff at a cost of 2,700*l.* per annum in salaries, three of the members being further entitled to pensions on retirement and having other emoluments, and four being provided with College Houses.

Under the proposed scheme the maximum total salary would be 2,200*l.* and the minimum 1,900*l.* There would thus be a considerable saving in cost, and yet such opportunities for advancement as would encourage good men to seek the appointments would be provided.

Supposing this scheme to be received with favour, I would submit further a claim to the appointment as Senior Professor of Engineering on the special pleas that I have served for 15 years as the Second Professor, and that I claim to be regarded as an expert in the portion of Applied Mechanics previously taught by Professor Reilly.

In support of this claim I may state that at the Royal Naval College, Greenwich, I, for several years, taught those subjects to classes of students some of which were considerably more advanced than has been found possible at Cooper's Hill.

Ever since leaving Greenwich I have acted as Examiner for the Royal Naval College in all the subjects of Applied Mechanics, and I have this year been appointed Examiner in the Mechanical Sciences Tripos for the University of Cambridge.

To meet the immediate exigencies respecting the present members of the staff, I would suggest that appointments (2) and (3) be made co-equal.

I have the honour to request that you will forward this letter to the Secretary of State for India.

I am, &c.,

The President. T. A. HEARSON.

(2.)

Colonel Pennycuick to India Office.

No. 391. Cooper's Hill,

Sir, 1st April 1899.

I have the honour to forward, for the consideration of the Secretary of State, a letter from Professor T. A. Hearson of this College.

As Professor Hearson specifically requests that this letter may be forwarded, I do not consider myself justified in withholding it, but I presume that the Secretary of State will not now desire to re-open the question as to the immediate arrangements for the teaching of engineering here.

I may say that for some time past I have been of opinion that an arrangement very similar to that proposed by Professor Hearson is the one to be looked forward to ultimately, but I have thought, and think still, that it could not be brought into operation until the time arrives for Professor Hearson's own retirement, and in any case, I should not support that portion of the proposal which is personal to himself.

I would suggest that I be authorised to inform Professor Hearson that the Secretary of State has decided upon the arrangements to be made, and that these will not involve any alteration in his position or duties.

I have, &c.,

The Under Secretary of State for India. JOHN PENNYCUIC.

APPENDIX 11.

Correspondence on Relations of Mr. Heath and Dr. Brightmore.

(1.)

From Colonel Ottley to India Office.

No. 65. Cooper's Hill,
Sir, 22nd January 1900.

I have the honour to forward, for the orders of the Secretary of State in Council, a letter (in original) received by me on Saturday from Mr. A. H. Heath, putting forward a "strenuous protest" against certain orders issued to him by Dr. Brightmore (with my previous approval) under the terms of the latter officer's appointment.

2. In order to make the matter perfectly clear, I also forward herewith a précis* of the whole case, which proves, I think, that the action taken by Dr. Brightmore and myself was not only the direct outcome of the orders issued by the Secretary of State, but was the only possible action open to us.

3. On the departure of Professor Reilly and General Courtney, the Secretary of State decided to amalgamate the chairs of Engineering and Surveying, and ruled that the new occupant of this chair of "Engineering and Surveying" should have the assistance of two assistants, and further that, subject to the President's approval, he should have the power of distributing the work between himself and his two assistants as seemed best to him.

4. Experience has shown that assistance must be given to Mr. Woods, *not* with a view to relieving him from work, *but* with the view to the more satisfactory teaching of surveying; the classes being too large for proper supervision and instruction out of doors by any single individual.

This being the position, it was decided by Dr. Brightmore, with my full approval, that this assistance could be most fitly given by the second assistant, Mr. Heath.

With regard to this decision I would invite your attention to the fact that it was not arrived at hastily or without full consideration. As will be seen from the précis, I declined in the first instance to move in the matter on the ground that I was new to the place and to the work, so that, as a matter of fact, I did not convey my approval to Dr. Brightmore's proposals until after the lapse of more than two months from the date on which the question was first considered.

5. To my mind there can be no possible doubt that Messrs. Woods and Heath are Dr. Brightmore's two assistants. It will also be observed (*vide* paragraph 7 of précis) that Colonel Pennycuick himself, though most strongly opposed to the Secretary of State's action, had no doubt whatever on this point.

It is true that Colonel Pennycuick has *now* thought fit to place a different meaning on his original letter (*vide* two letters in original received to-day and forwarded, marked A and B; also see P.S. to my précis). I am, however, quite unable to reconcile Colonel Pennycuick's present statements with his original letter quoted in paragraph 7 of précis.

It seems to me, moreover, worthy of note that Mr. Heath is very careful not to say that he did not know of the changes that had been ordered by the Secretary of State. All he urges in this respect is that he never received any *official* intimation of the facts. If this were necessary, it was clearly the then President's business to have communicated the same. In any case it would be difficult to explain the reason for Dr. Brightmore's writing to Mr. Heath on any other grounds save that he considered Mr. Heath his assistant. All arguments, therefore, based on the plea of ignorance must, I think, be accounted as special pleading.

6. It will be observed that the position assumed by Mr. Heath is (1) that he has always held an independent charge, (2) that the orders making him an

* Not printed.

assistant of Dr. Brightmore conflict with his own letter of appointment, and (3) that any such change in his position is "remote from a just and honourable "treatment of one who has always endeavoured, to the best of his ability, "to serve the College loyally and faithfully during the past twenty-four "years."

7. The claim of complete independence thus set up is clearly not in accord with the orders of the Secretary of State, as issued to Dr. Brightmore. The claim moreover is, in my judgment, not sustainable, either with reference to Mr. Heath's own letter of appointment, or, so far as I can see, from any other point of view, and I go so far as to say that, in my opinion, the admission of any such claim would be absolutely fatal to the best interests of this College.

Whether it is proper to describe the effect of the orders of the Secretary of State as being "remote from a just and honourable treatment," is a matter that I may well leave in your hands.

8. I must add that, apparently under a misconception, Mr. Heath did not attend the surveying classes on the 18th and 19th as directed, but on my taking him to task about this, and pointing out to him that pending the orders on his protest, he must obey, he has signified his intention of doing so, and, as a matter of fact, did attend to-day. In view, however, of the general tone of his correspondence, and of the position he has thought fit to take up, I cannot think that there is much probability of his working harmoniously with Dr. Brightmore in the future, and this, I think, is a matter to be borne in mind when dealing with the case.

I have the honour to be,
Sir,
Your most obedient Servant,
JOHN W. OTTLEY,
President, R.I.E.C.

(2.)

Enclosure in (1).

From Mr. Heath to Colonel Ottley.

The Royal Indian Engineering College,
Cooper's Hill.
19th January, 1900.

Sir,

I have received from Professor Brightmore a letter *stated to be issued with your sanction*, which *appears to give me an order to take up certain duties* in the surveying course of instruction at this College.

1 had myself on 16th instant personally informed Mr. Heath that the instructions to him had my approval and had been issued with my sanction.
J. W. O.

It most distinctly is an order which Mr, Heath chose deliberately to disobey on both the 18th and 19th instant.
J. W. O.

Against the terms of this letter I beg to state my strenuous protest. In August 1875, on the nomination of the then President, Colonel G. Chesney, R.E., I was appointed by the Secretary of State an Assistant Professor of Engineering at this College, subject to the regulation that I performed the duties of the appointment to the satisfaction of the President, and I undertook those duties under the President's authority, and in consultation and agreement with my then colleagues in the engineering branch of studies, Professors Callcott Reilly and W. C. Unwin. These duties were entirely distinct and separate from the conduct of the surveying course of studies, then carried on by the appointed Professor and Instructor in surveying. *One protest* is that the surveying course does not come within the duties for which I was appointed an Assistant Professor of Engineering.

In September 1898 I was requested by then President, Colonel J. Pennycuick, R.E., to take sole charge of the surveying course alone, as the Professor of that course had retired from his duties at the end of the previous session, in July 1898. This duty I carried on for the Session 1898-99, my duty in the engineering branch being otherwise provided for by the President. In the following

session (now current) other arrangements were made, and I have resumed my former duties.

In performing my duties at this College I have been subject to the authority of the President alone, and not subject to the authority of any of my colleagues, nevertheless acting in harmonious consultation with them.

I have had no intimation from any *official* source that there was any proposal to make any change in my duties or position at this College; I am not informed as to the detailed conditions of Professor Brightmore's appointment, but understand that my name is not mentioned as an Assistant to the Professor of Engineering. Had such mention been made, or had such intimation been received by me, my course of action in protesting would have been similar to the present. Into the grave question of the practicability of my taking up permanent additional duties, I do not propose now to enter.

Note the word "official." Mr. Heath does not say that he did not know of the orders, but states that he had no *official* notice.

J. W. O.

I have informed Mr. Heath that the then President distinctly informed Dr. Brightmore that *Mr. Heath was one of the two assistants.*

J. W. O.

I am quite satisfied that he could do the work perfectly so far as his other duties are concerned.

J. W. O.

I beg most respectfully to put before you my conception that any such change in my position and addition to my duties, as set forth in Professor Brightmore's letter, would appear to be remote from a just and honourable treatment of one who has always endeavoured, to the best of his ability, to serve the College loyally and faithfully during the past 24 years, and whose services have been cordially acknowledged by the successive Presidents of the College.

I append a copy of Professor Brightmore's letter to me, and have the honour to be,

Your obedient Servant,
A. H. HEATH.

To the President,
Royal Indian Engineering College.

(2A.)

ENCLOSURE in Mr. Heath's Letter to Colonel Ottley, dated 19th January 1900.

From Dr. Brightmore to Mr. Heath.

Egham Hill,
13th January 1900.

Dear Mr. Heath,

At the beginning of last term, owing to the circumstances of the case, I thought it best to take up myself that part of the course which was not provided for, without any consideration as to whether I should continue to perform that particular work myself in future.

This work was,—(1) That formerly carried on by Professor Reilly, and (2) taking one section in each division of the surveying classes. I did the latter because I considered that to make the classes of reasonable size two instructors were required. The President is also of this opinion. I have now decided, as provided for in the terms of my appointment, and with the President's approval, to continue Professor Reilly's work myself, and to ask you to take up the work connected with the surveying classes that I did myself last term. The President gives this scheme his entire approval, and I shall be pleased to show you his written statement to that effect, in which he says:—" . . . . as matters stand at the present moment I entirely " concur with you that this help should be given by Mr. Heath, who should " be required to teach one half of each division, while Mr. Woods instructs " the other half." As the President points out, this necessitates a change in the timetable, viz., that you should lecture to the third year on Wednesday from one to three, instead of on Tuesday, and that I should on Tuesday instead of on Wednesday at the same time.

I am,
Yours very truly,
A. W. BRIGHTMORE.

(3.)

Enclosure in (1).

From Mr. Heath to Colonel Ottley.

Cooper's Hill,
Englefield Green, Surrey,
20th January 1900.

Dear Colonel Ottley,

Colonel Pennycuick was at the football match this afternoon, and I asked him as to his having written to Dr. Brightmore stating that I was to be one of his (Dr. B.'s) assistants.

Colonel Pennycuick's answer was that he had declined to take action in the matter, leaving it for his successor in the Presidentship, that his letter was of a private nature, mentioning my name as an Assistant Professor, but without any bearing on the question of Dr. B.'s assistant. Colonel Pennycuick has kindly given me permission to repeat this to you.

As I mentioned to you, I have Colonel Pennycuick's written statement—
" I am prepared to testify that, as long as I was President, I considered you
" as responsible to myself, and not to any other member of the staff."

I am sorry to be such a trouble to you over this matter.

Believe me,
Yours very truly,
A. H. HEATH.

(3A.)

ENCLOSURE in Mr. Heath's Letter to Colonel Ottley, dated 20th January 1900.

From Colonel Pennycuick to Mr. Heath.

Silourie, Camberley, Surrey,
21st January 1900.

My dear Heath,

Your letter, which I return, correctly represents the substance of our conversation yesterday.

I cannot remember precisely the circumstances under which I wrote the letter to Dr. Brightmore which you mentioned, nor the exact time of it, but as far as I remember it was merely to say that he must arrange the distribution of work with you and Woods, subject to the approval of the new President, who had not then been appointed. It is possible that I may by inadvertence have spoken of you as one of his assistants, but this could only have been a careless expression, and cannot be held to prejudice the undoubted fact that you have always, so far as I know, been subject to the control of the President only.

I am bound to add that I do not think the letter should have been used as Dr. Brightmore has used it without my consent.

You can make any use you please of this letter, and it might be well for you to send it to Colonel Ottley with your own.

Yours sincerely,
JOHN PENNYCUICK.

(4.)

From India Office to Colonel Ottley.

P W. 145.

India Office,
13th February 1900.

Sir,

I am directed by the Secretary of State for India in Council to acknowlege the receipt of your letter of the 22nd January 1900, enclosing copy of a protest which has been addressed to you by Mr. Heath, Assistant Professor of Engineering, against instructions being given him by the Professor of Constructive Engineering and Surveying to take part in the teaching of surveying.

2. In reply I am to observe that the orders of the Secretary of State conveyed to the then President in the letter from this Office of the 14th February 1899, clearly indicated that the two Assistant Professors in the Engineering branch were to be subordinate to the Professor of Constructive Engineering and Surveying. The instructions given to Mr. Heath by Dr. Brightmore were therefore issued under the authority duly invested in him, and he should accordingly be officially informed that any inability on his part to accept the orders of the Secretary of State on this point would be incompatible with the retention of his appointment at the College.

I am, Sir,
Your obedient Servant,
HORACE WALPOLE.

Colonel J. W. Ottley, R.E., C.I.E.,
President, Royal Engineering College.

APPENDIX 12.

Reports received from India on the Training of the Telegraph Officers appointed from Cooper's Hill.

No. 1.

Note dated the 2nd August 1895, by Mr. C. H. Reynolds, C.I.E. (Director-General, Indian Telegraph Department, 1895-98), on the Recruitment in England of Assistant Superintendents for the Indian Telegraph Department.

For the past 17 years the Superior Officers of the Indian Telegraph Department have been trained at Cooper's Hill, and I am not aware that any change in this matter is contemplated, but I have thought it might be useful if I placed on record a few remarks on the results that have been attained and upon any points where the system seems to fail in completely supplying our wants.

In former years the whole of the Superior Staff was recruited from England, while at present a portion is supplied from the Roorkee Engineering College in India as Provincial Officers on a reduced scale of salaries. To justify the continuance of the supply from England, and the superior pay enjoyed by those thus recruited, it is evident we must obtain from England men with higher and different qualifications than possessed by those recruited in India.

It need hardly be said that it is absolutely necessary for the Government of India to recruit a portion of the Superior Officers of the Telegraph Department from England; not alone is this necessary to obtain men scientifically trained in a better school than is available in India, but in the Telegraph Department, as in most branches of the public service, India requires a proportion of officers of good physique and of English home and public school training to impart tone and morale to the service generally and to set a good example in pluck, endurance and conscientious work to those in the department who have not had similar advantage in bringing up.

But in addition to the qualifications that go to make up the English gentleman, supplemented by special training in the ordinary work of a telegraph engineer, the department requires from its officers recruited in England, or at all events a portion of them, a certain amount, and in fact as large an amount as practicable, of higher technical training in the more advanced fields of electrical research. Our knowledge of electricity is admitted to be in its infancy; at the same time there is no branch of science which is attracting more attention now-a-days and in which greater progress is being made. Again the immense continent of India offers an unlimited scope to the economic application of the powers of electricity, not alone in telegraphy and telephony, but in electric lighting, power, and traction, and possibly in many other fields which will open to future generations. It is therefore a matter of vital importance to the Government of this country that in its Telegraph Department it should possess some officers who have been trained in the most advanced school in this science, and who by natural taste, aptitude and early associations will, after their arrival in India, keep up their scientific connections in England, and as far as possible keep abreast of the progress constantly going on.

It has been pointed out by previous Directors-General that the Department does not want merely a number of budding professors, as it is a well known fact that a taste for scientific research is too often not found combined with activity, common sense, business aptitude, and the qualifications necessary to get work done in India, but at the same time there is, I think, no doubt that the Department will benefit greatly by an increased infusion of scientific training among its officers, and this of the right sort too can, I believe, be got by introducing a little variety into our method of recruitment.

Cooper's Hill has supplied the Department with many valuable officers, but it is a noticeable fact that among those officers there is, with a few exceptions, an absence of anything like enthusiasm in the scientific branch of their work. This may, I think, be clearly traced to their training. Entrance to the Department being through an expensive college like Cooper's Hill, our field of selection is enormously reduced. Moreover, Cooper's Hill is not a recognised school of repute in connection with advanced telegraph engineering, and residence in it does not help to bring the telegraph students in contact with the electrical world generally. Again, the training in a college of this kind, where games and field sports hold a large place, and where there is a large mixed body of students, is not calculated to develop a desire to take up electrical science as a speciality or to encourage private study and laboratory investigation. There is an inevitable tendency on the part of the students to look just to passing these examinations, and to relegate their acquirement of practical knowledge to the time when they will be actually engaged on work in India.

In my opinion, however, we want a strong leaven of young officers who have to some extent graduated in serious technical work before they even thought of coming to India. We want to get men who, though still quite young, have done a few years' practical professional work in England, and who have thus developed qualifications and applied their knowledge in a way impossible in a college like Cooper's Hill. In fact we want our students, or some of them, to come out to teach us in India the latest advances in technical knowledge, not to come out to learn their work. The knowledge of such students will be less ephemeral than men training for an examination, and we have a good probability that by keeping up their connections with the electrical world at home and by renewing their associations when on furlough, our officers will not rust, as it is too often the case in India, and will grow sound and useful advisers to Government.

To obtain students of this class we must go to the large electrical manufacturing firms for engineers who have served their time, or to such men as Mr. Preece, C.B., F.R.S., Professor Ayrton, F.R.S., Professor Silvanus Thompson, F.R.S., &c., who by their duties are daily brought into contact with the class of officers we want. I believe that with the age of admission for such officers raised to say 26, we should have no difficulty in the present state of competition for employment in England in obtaining on the same pay and prospects as are now given to Cooper's Hill students, an ample selection of thoroughly practical men, provided with diplomas of qualification that would obviate the necessity for examination. I am well aware that this result could not have been obtained a few years ago, but a great change has come over England, and so many young gentlemen are now being trained for the profession of electrical engineer, that I feel confident that if we only go to the right source for the supply of officers thoroughly trained, technically and practically, we shall be able to supply all our needs.

I do not recommend that electrical engineers of standing should be brought out in the higher grades. There are many risks and objections to such a course. It is always doubtful if a man of formed English habits and connections will care to stay in India, or if his health will stand. His being brought in in the higher grades, moreover, interferes with promotion and causes discontent. I believe we should get our technical knowledge much more satisfactorily by obtaining young men from time to time in the manner I have indicated above.

No. 2.

LETTER from Mr. C. E. Pitman (Director General of Telegraphs, 1899–1900) to the Secretary to the Government of India, Public Works Department.

Simla, the 21st July 1899.

SIR,

I HAVE the honour to enclose copies of the correspondence marginally noted for the information and consideration of the Government of India. These papers relate to the Course of training undergone by telegraph students at the Royal Indian Engineering College, Cooper's Hill, and I would submit (and my opinion is shared by every Telegraph Officer of any position to whom I have spoken on the subject) that the present course is not only capable of great improvement, but that it is inadequate and in many ways unsuited to the requirements of this Department.

1. Note on Cooper's Hill Course, by Mr. E. A. Kenyon.
2. Note on Cooper's Hill Course, by Mr. A. J. L. Grimes.
3. Note on Cooper's Hill Course, by Mr. M. G. Simpson.
4. Note on Cooper's Hill Course, by Mr. M. A. Thompson.

2. Officers on joining the Department have very little knowledge of technical matters connected with their profession, and it is consequently necessary on their arrival in India to put them through a course of testing and signalling and also to require them to spend two or three months in the workshops, after which they are attached to a Presidency Signal Office to learn office routine and traffic matters. During this period they are also required to study Hindustani.

3. I attach copies of the orders which are issued regarding the instruction of newly joined officers, and would remark that in order to shorten this course of instruction and improve the system of training, orders have lately been issued that, in future, Cooper's Hill officers, who generally reach India in October or November, shall, on arrival, be attached to a healthy division for instruction in construction, maintenance and sub-division work during the winter months, and after that be put through a course of training in the workshops, electrician's office, and a large signal office.

4. This arrangement should result in shortening the period of training in India by four or five months.

5. Now as regards the Cooper's Hill training which, in the case of telegraph students, extends to two years.

First Year.

The course of study for the first year, which is the same for Public Works Department and Telegraph students, should continue unchanged except that I would recommend that French and freehand drawing be made obligatory for telegraph students, as a knowledge of these subjects would be most useful. French is the language used at the International Conferences and in all correspondence from the Berne Bureau, and the ability to sketch would be most valuable in the case of officers employed on survey work on the frontier or beyond the limits of India. The course comprises the following subjects:—

(1) *Mathematics*—

Algebra, trigonometry, conic sections, integral and differential calculus, statics, hydrostatics, dynamics, logarithms, kinetics, kinematics.

(2) *Surveying*—

Surveying with chain, dumpy level and sextant with problems thereon. Most of the surveying done is on roads or across country, a certain time being allowed for field work and afterwards for plotting and drawing.

(3) *Chemistry*—

Lectures on inorganic chemistry, and for practical work the "Analysis of Salts."

(4) *Drawing*—

First Term.—Problems in plane geometry, and during the latter half solid geometry is begun.

Second Term.—Solid geometry, drawing and designing roofs, staircases, &c.

Third Term.—As above, only more advanced.

(5) *Physics*—

Only theoretical during the first year. Lectures on "Heat." Text-book—Ganot's Physics.

(6) *Geology*—

This subject, which includes physical geography and geology proper, extends over two terms only.

(7) *Architecture*—

This subject is taught in the third term only.

(8) *Workshops*—

In addition to the obligatory attendances, other attendances have to be put in. The latter are optional, so far as relates to dates and hours of attendance. Students (who have to provide their own castings and tools) can make what articles they prefer; large vices, lathes, engines, &c., being generally chosen.

French, German, and freehand drawing are voluntary subjects, and any one can be taken up as an extra, lectures being given once a week.

Second Year.

Special Course for Telegraph Students.

Appointments in the Telegraph Department are offered in the order of merit of the examination held at the termination of the first year's course.

The selected students then undergo a special course of one year in the following subjects:—

(1) *Mathematics*—

Telegraph students no longer take up pure mathematics, but do practically the same course in applied mathematics as the second year engineers. This is in reality a continuation of the first year's course, but is more advanced. The subjects are not taken in turn or dealt with separately as in the first year, but examples are taken which require a knowledge of all subjects. Catenaries are also lectured on.

The examinations at the end of the first two terms of the special course are the same as those for the second year engineers, but the final examination at the end of the midsummer term is not set by an outsider, as in the case of the engineers, but by the Applied Mathematics Professor, and includes questions on the whole two years' course. At the end of the same term there is also an examination in logarithms.

(2) Telegraph students also have to go through a course of Applied Mechanics, practically the same as that for the second year engineers. It includes finding the strains, stresses, working loads, factors of safety, bending moments, elasticity, shearing forces, &c., of girders and beams of various, and under different, conditions; also the drawing of graphical statical application plates on the examples in the Applied Mechanics course.

(3) *Telegraph Construction*—

A short line of three posts and two wires is put up. The students are supplied with logs or tree trunks from which they shape the poles, planing and painting them. They dig the holes for the posts and stays, making and fitting the latter, and also make and solder joints, and in fact do everything relating to the construction of a line.

All this work is done in the summer term.

During the Christmas and Easter vacations students are required to read up a certain quantity of construction, but as the text-book, "Douglas'

Manual of Telegraph Construction," like other books on telegraph subjects which are in use at Cooper's Hill, deals almost entirely with English telegraphy and wooden posts and is thoroughly antiquated, they do not derive much benefit from it.

(4) *Signalling*—

After learning the alphabet, the telegraph students do one hour's signalling a week, and as their rooms are connected, and there is an instrument in each, they can practice as much or as little as they like. An examination is held at the end of each term, that at the end of the summer term being conducted by a clerk sent down from the General Post Office, London.

This examination consists of signalling, reading from tape on which the signals are recorded and by sound, and the adjustment of sounders, relays, and inkwriters.

The minimum speed required at the end of the year is 10 words per minute.

(5) *Workshops*—

This course is divided into practical and theoretical.

Practical.

The students first of all make joints of all kinds and are taught the use of the axe, adze, bassoolah, paring chisel, drawknife, spoke shave, plane, files chipping and turning chisels and saws, how they are made and for what purpose they are used. A few tools are also made by the students.

The above, together with the theoretical portion of the course, occupy the best part of 1½ terms.

The carpentry course ends with the students making a piece of furniture, &c. In 1898 a picture frame was selected.

They next have to make an electrical or telegraph instrument. Two of the students, who joined the Department in 1898, each made a General Post Office pattern relay, while the third made an electric bell.

The manufacture of these instruments took up the rest of the course, as the students had to make every part of the instruments themselves.

Theoretical.

This portion of the course includes the various methods of telegraphic working such as simplex, single needle; double current; universal battery; differential, bridge and split battery duplex; multiplex; quadruplex, repeaters and Wheatstone's automatic system with and without transmitters.

The students are taught how to connect up these instruments and how to find the amount of battery power required to work any circuit, as well as the use of the instruments, relays and signalling keys used for the above-mentioned methods of working.

This instruction is, however, only theoretical, as the supply of instruments is very limited, consisting only of a few relays and sounders. Lectures are also given on the various kinds of lightning protectors or dischargers, as they are termed in India, *e.g.*, Varley's, Siemen's, the cable, carbon, and vacuum.

(6) *Telephones*—

Very little instruction is given, the subject being treated briefly and hurriedly—

The Edison, Bell, Blake, Hughes, Hunning and Gower Bell Transmitters and the Bell, Blenheim, Horse Shoe and General Post Office Receivers being dealt with. The text-book in use is "Preece and Sivewright's Telegraphy."

(7) *Physics*—

Theoretical.

The course on Electricity and Magnetism includes:—

Electric fields.
Measurement of Forces.
Forces acting on spheres.
Work done in moving charges.

Potentials.
Charging condensers.
Shunts.
Magnitude of magnetic force.
Galvanometers.
Energy given out in circuit.
Joule's, Ohm's and Faraday's laws.
Magnetic action of current.
Capacities of condensers.
Curves of magnetization.
Mutual induction.
Induction, Dynamos } only touched on.

Text-book chiefly used "Silvanus Thompson's Elementary Lessons on Electricity and Magnetism."

Practical.

6. The physical laboratory course lasts the whole year and consists of experiments, among which are:—

Finding specific heat.
Finding electro-motive force of various cells by different methods.
Finding unknown resistances of various cells by different methods.
Finding internal resistances of cells by different methods.
Finding electro-chemical equivalent of copper.
Determining polarisation of cells.
Determining resistances of galvanometers.
Comparison of condensers by different methods.
Leakage of condensers by different methods.
Measurement of earth resistance by tangent galvanometer.
Measurement of earth by Wheatstone's Bridge.
Finding absolute capacity of condensers by different methods.
Finding resistance between two points in a wire.
Fault testing { Murray's loop method. Fall of potential method. Varley's method.
Standardising voltmeter.
Finding insulation resistance of insulators by quadrant electrometer.
Determination of H. and K.
Finding candle power of glow lamps.
Dynamos. A few experiments to find the potential round commutator, external and internal characteristic.
Making up Minotto and storage cells.
Text-book—Steward and Gee.

(8) *Chemistry*—

A practical course consisting of the "analysis of salts and phosphates."

(9) *Accounts*—

During the Easter and Summer terms, weekly lectures are given on this subject, and the students make entries in day book, journal, ledger, cash book, profit and loss, and balance sheets.

(10) *Mechanical Workshops*—

This is a short course consisting of practical experiments as to the elasticity, toughness and resistance to crushing of iron and steel in different forms.

7. This account, which, I believe, gives a fair idea of the Cooper's Hill course at the present time for telegraph students, has been taken from a memorandum drawn up at my request, by Mr. M. E. Nigel Jones (who joined the Department from Cooper's Hill in October 1898) in consequence of representations made to me by officers recruited from that institution.

8. On receipt of that memorandum, I addressed the following Cooper's Hill officers and asked for their opinion on the course, and whether they considered any modification necessary.

Mr. E. A. Kenyon, Superintendent of Workshops, joined the Department, September 1880.

Mr. A. J. L. Grimes, Superintendent of Dacca Division, joined the Department, July 1885.

Mr. M. G. Simpson, electrician, joined the Department, October 1887.

Mr. M. A. Thompson, on special duty, joined the Department, October 1895.

9. Mr. Thompson, who for the past 12 months has been on special duty in connection with the examination of the signalling establishment held every five years, is at present, though very junior, acting as electrician. He is an officer of exceptional attainments, and, as I am informed, obtained the highest recorded marks for the telegraph course. The others are all officers of experience and sound judgment.

10. Copies (Annexures 1, 2, 3 and 4) of the statements submitted by these officers are attached, and I may say I generally concur in their recommendations which refer to the 'second year only, and with which I will now deal with in the order given in Mr. Nigel Jones' memorandum.

Mathematics.

11. The course is an excellent one and no alteration is necessary. The training in this branch should enable officers to read with advantage in after life professional books which would otherwise be closed to them.

Telegraph Construction.

12. The course in no way applies to India, and our recruits arrive in this country knowing practically nothing of a class of work on which the majority of officers are chiefly employed for the first few years of their service. Wooden posts are seldom used in India, and even in districts where hitherto it has been convenient to use them, their use is steadily decreasing. I think the course should include instruction in the use of tubular iron posts, a few of which of the standard pattern with a supply of fittings, *e.g.*, brackets, insulators, braces for coupled posts, &c., might be provided at the College. Students, however, should continue to be taught the properties of wooden posts and the various methods of preserving them from decay. The departmental pamphlet on "Spans" might be supplied as a text-book on the subject which is an important one.

In this part of the course particular attention should be given to angles, the strain on angle posts and insulators, the limit of safety as regards posts and insulators, carrying capacity of posts, stays, necessity for stronger posts at angles and terminals; shackles where necessary; dip and breaking strain of wire.

Various kinds of iron wire should also be supplied for practical use, their properties explained, and students instructed in the methods of straining them with block and tackle.

As regards soft and hard drawn copper wire, this material is expensive and easily damaged to such an extent as to render it unfit for use, and beyond supplying samples, it is not considered necessary that wire of this kind should be provided. The same remark applies to field service cable.

Officers can be thoroughly instructed with regard to these materials after their arrival in India.

The students should be taught to make joints, solder, and test them and wire for breaking strain, and also test wire by the torsion test, bind insulators, and all other details of construction work including paying out and picking up wire. I am informed that the students are taught to heat the joint with a spirit lamp and to then apply the solder, a method expressly forbidden by the Construction Code, as heating renders the wire—especially steel wire—brittle.

Tools of all kind used in India should be provided and their names and uses taught. Iron masts of various lengths running in some cases to 150 feet are often used in India to span rivers. It is not considered necessary to give any practical instruction in England concerning them, but as temporary masts of wood or bamboos have often to be made on the spot, it is advisable that the students should be taught how to splice wooden posts, and the principles of mast construction. A knowledge of the various methods of splicing would be most useful, as even on a wooden line it may sometimes be necessary to splice a broken post in order to effect temporary repairs. Useful information on this subject is to be found in Douglas' Manual of Telegraph Construction which, though obsolete in many matters relating to telegraphy, might be retained in the library for reference.

As regards text-books, it is recommended that the Departmental Construction Code and Book of Diagrams of Construction Stores be used, instead of Douglas' Manual of Telegraph Construction. The latest edition of Preece and Sivewright's Telegraphy should continue to be used.

If space is available, a longer line than a three post one should be put up so that examples of angles, a very important subject, may be given.

Signalling.

13. This is another very important subject, as no officer receives any acting or permanent promotion until he has passed in India the prescribed test which is described in Annexure H. This he generally does within a year of his arrival.

The present course which consists of one hour's work a week, and as much, or as little, practice as the students like to do in their quarters, is quite inadequate. Systematic and regular training under proper supervision is required, as, if left to themselves, the students acquire a bad style and signal irregularly without regard to the space between signals, letters and words. Mr. Melhuish's "Instructions for teaching Probationers the Morse Code" is a pamphlet that would probably be found very useful.

It is understood that the signalling instruments in use are two inkwriters—very useful instruments for recording signals on tape—which are taken to pieces by the students and put together again year after year; if so, it is probable they cannot be properly adjusted, and it is advisable two or more Siemen's sounders be supplied for practice purposes.

These instruments should not be taken to pieces like the recorders.

Workshops.

Practical Course.

14. *Carpentry.*—It seems unnecessary to teach the students *all* the joints mentioned or to require them to make such articles as picture frames.

Tools.—To those enumerated might be added the telegraph tools in use in India.

Metal work, etc.—Turning wood and metal is very useful, but instead of requiring the students to entirely make a new instrument, it would be better for them to take to pieces and refit such instruments as they would have to use in India, for which purpose special instruments could be supplied having regard to the limitation in paragraph 13.

Theoretical.

This course should be supplemented and improved by supplying the students with instruments of the patterns used in India and requiring them to connect them up and work them.

They should be taught the various circuits, closed and open systems of working, the current required for each instrument and its proper adjustment and how to test these instruments.

The Departmental Technical Instructions should be supplied for this course and James' Morse Signallers' Companion.

Telephones.

15. This is a very important subject, to which far more attention should be given, as the use of these instruments is extending rapidly, and officers may be required at any time to fit them up either for commercial or domestic purposes or on active service.

Not only should the theory be fully explained, but various patterns of telephones should be supplied, and the students allowed to take them to pieces and put them together again so as to make themselves thoroughly acquainted with the mechanism.

The departmental note on telephones, revised to 1st January 1897, might be supplied.

Text-Books.

A Manual of Telephony by Preece and Stubbs.
The Practical Telephone Hand-book by J. Poole.
Indial Telegraph Departmental Technical Instructions.

PHYSICS.

Theoretical.

16. This is another subject of such great importance that I cannot do better than quote *verbatim* from Mr. Simpson: "The electrical part of the present course, excellent as it is in many respects, does not seem to impart a really practical working knowledge of the subject."

"The text-book from which they derive their elementary knowledge is a small book by Professor Silvanus Thompson written many years ago, and in which a good deal of space is occupied by statical electricity of very little importance."

"I would suggest that they use Ayrton's Practical Electricity which is very simple, and more modern, and thoroughly practical. The course in the physical laboratory should be made to fit in with the book. Any student with aptitude for experimental work will find plenty of time for additional physical experiments such as they do now."

"What I wish to emphasize is that the present physical laboratory course is excellent but not practically useful, whilst if made to fit in with Ayrton's book, it would be equally excellent educationally and have a practical value in addition."

In electricity, which is developing so rapidly, the most modern books should be used for instruction, and the methods now in use in India taught instead of those (*e.g.*, "Split Battery" duplex) which are not used.

Physical Laboratory.

17. All the physical laboratory work is excellent, but it would be an improvement if the students were taught regular and fault testing of lines by means of an artificial line. At present they know nothing of regular tests when they reach India, and their fault testing is confined to Murray's loop test.

It would be very useful if they were also taught to measure the insulation resistance of a cable by means of the reflecting galvanometer and something about the "Electrification Curve." In Burma, Arakan, Assam and Bengal, there are many river cables as well as two long sea cables in the Madras division between India and Ceylon, and officers are often required to test them.

Chemistry.

18. This subject might be omitted during the second year, and the time devoted to other purposes.

Accounts.

19. As the Indian telegraph system of keeping accounts is entirely different from that which obtains at home, it is recommended that the present course be abolished.

Mechanical Workshops.

20. This is a good course as it teaches the methods by which the breaking strain and the elastic and other co-efficients of a sample are obtained, but as regards "mechanics applied to construction" the course might well be curtailed.

All that a telegraph officer requires to know are the chief co-efficients such as "Young's Modulus," "Poncelet's Co-efficient," the effects of a strain exceeding the elastic limit on a bar of metal, &c., but the calculations of tensions and compressions in the members of a roof frame, or bridge girder seem unnecessary.

21. The subjects mentioned in Mr. Nigel Jones' memorandum have all been dealt with now, but I should like to offer a few remarks as regards subjects not provided in the curriculum.

Construction Code.

22. A knowledge of this very useful book from the preamble to page 47, and from page 104 to page 134, would be of great advantage.

Hindustani.

23. As telegraph officers are now required to pass by the lower standard before receiving promotion, more attention should be given to Hindustani. What the students should acquire in England is a sound grammatical knowledge of the language.

24. In submitting these recommendations, I would ask that it may be borne in mind that my object is not to unduly criticize the course of instruction at the Cooper's Hill College, which has supplied the Department with so many excellent officers, but to bring to the notice of the responsible authorities that it would be possible to greatly improve the course of instruction and turn out officers with a greater knowledge of the theory and practice of Indian telegraphy than they can now obtain.

25. Should the Government be pleased to accord a general approval to these proposals, I would recommend their being referred to the College authorities for favour of opinion, and I would mention that if any change be decided on, it would be an advantage to introduce it after the summer vacation of the current year.

26. Mr. Kenyon in his note (Annexure D) suggests the advisability of putting a telegraph officer on the Council of the College, and although the rules may not admit of this suggestion being carried out, I think it will be admitted that the advice, and assistance, of such an officer would be very valuable. The educational staff of the College cannot be expected to give adequate instruction in such a subject as telegraphy in all its branches as applied to India, and the supervision of an expert in such a subject is very necessary. Another way of overcoming the difficulty would be to appoint a retired telegraph officer as lecturer or demonstrator in Indian subjects for a fixed period. There should not be any difficulty in making such an arrangement. Cooper's Hill is very accessible from London, and there are doubtless many officers who would be glad to take up such work for fair remuneration. Any such appointment, if sanctioned, should not however be for an unlimited period; but for not more than three or five years, as up to date instruction is essential.

27. I append a general summary of recommendations and would, in conclusion, lay stress on the fact that it is the Cooper's Hill officers themselves who consider reform is required, and that they have taken the initiative in suggesting certain alterations in the present curriculum.

28. It is difficult for me with but a very slight knowledge of the institution to write on such a subject, but I trust I have stated the case clearly.

I have the honour to be,
Sir,
Your most obedient Servant,
CHARLES E. PITMAN,
Director-General of Telegraphs.

GENERAL SUMMARY OF RECOMMENDATIONS.

1. French and freehand drawing to be made obligatory.

2. *Workshops. Practical Course.*

Omit some of the joints, and instead of requiring the students to make any one instrument let them learn to take to pieces and put together again as many instruments as they are likely to constantly meet with in India.

3. *Workshops. Theoretical.*

In addition to explaining the various circuits, students should be afforded an opportunity of acquiring practical experience.

The "Technical Instructions" issued by the Indian Telegraph Department should be used as a text-book and James' Morse Signallers Companion.

4. *Telegraph Construction.*

Course to be made more applicable to India, wooden posts and fittings being discarded in favour of the iron posts used in India. Replace Douglas' Manual of Telegraph Construction by Preece and Sivewright's Telegraphy, the Indian Telegraph Department Construction Code, Diagrams of Construction Stores and Span Pamphlet.

5. *Signalling.*

More time to be given to this subject under proper supervision. "Instructions for teaching Probationers the Morse Code," by Mr. W. F. Melhuish, late of the Indian Telegraph Department, should be supplied as a text-book and some sounders of the Indian pattern for practising with.

6. *Telephones.*

Full instruction in this most important subject is very necessary.

7. *Physics.*

(1.)—*Theoretical.*

Ayrton's "Practical Electricity" recommended as a text-book instead of Professor Silvanus Thompson's book.

(2.)—*Laboratory.*

The course should be made to fit in with the text-book recommended above. The regular and fault testing of lines and cables should be taught and the "Electrification Curve."

8. *Chemistry.*

This subject to be omitted in the second year.

9. *Accounts.*

Abolish the present course.

10. *Mechanical Workshops.*

Course to be curtailed and confined to subjects which relate to telegraph matters.

11. *Construction Code.*

A knowledge of this very useful book would be of great advantage.

12. *Hindustani.*

More attention to be given to this subject in which officers must pass before receiving any promotion.

CHARLES E. PITMAN,
Director-General of Telegraphs,

Simla, the 21st July 1899.

ANNEXURES to Mr. C. E. Pitman's Letter.

Annexure 1.

Note upon Cooper's Hill Course by Mr. E. A. Kenyon.

You ask for note on above, but, without knowing exactly what course the men now go through and what books they use, it is difficult to offer suggestions for alterations. During the first year at Cooper's Hill our men go through the same course as the Public Works Department men, and they only have one year's training in telegraph work; so that in making alterations and additions to the course, care must be taken not to try and cram in too many things.

All the mathematical work and all the survey work I believe to be good and would make no alteration in it. The laboratory course is much of it probably useful, but I believe much might be improved on. The Electrician will note more specially on this, I believe; but I would suggest that no time be spent in the chemical laboratory, but should rather be given to practical testing and electrical work similar to that done out here and with the same instruments. Also if they learn anything about duplex and quadruplex work, existing methods should be taught; whereas the men are now taught that "Split Battery" duplex is the system used in India.

As regards construction, Douglas' book is the text-book; and the men go through a course of peeling larch poles, digging holes, fitting wooden brackets, and so on. They know nothing of our system. Here I think a radical change is necessary. The Construction Code and diagrams should be supplied to them, and specimens of all our standard patterns of construction stores and tools; and they should know the names and uses of these before they come out here. This I think more important than any other change; because it is mainly construction and maintenance work they have to do for the first 10 years of their service. They might possibly be given estimate and completion report forms and store account books to learn the use of, with the necessary instructions from Chapter I.; but beyond this I would not teach them any accounts at Cooper's Hill. The parts of the Construction Code they might specially learn are from the preamble to page 47, and pages 104 to 132.

In workshops work they should learn to joint iron and copper line wire in accordance with the Construction Code, and with the same tools that we use; but beyond that I do not know that any special telegraph work is necessary.

If they still have lectures on stresses and strains on girders, beams, roofs, and so on and on applied mechanics, these might be discontinued.

As regards traffic, I do not think it advisable to try and make men learn that at Cooper's Hill, but I think signalling should be made more a point of, and the signalling examination at Cooper's Hill should be strictly in accordance with our rules. The last batch of men did not in the least understand why a whole word should be counted wrong in an examination because one letter was wrong.

With a view to keeping the work at Cooper's Hill in touch with work out here, would it not be possible to appoint a telegraph man to a seat on the Council of the College? He would presumably be a recently retired man and would be changed every few years.

The 8th of April 1899.

E. A. KENYON,
Superintendent of Workshops.

Annexure 2.

Notes on the Cooper's Hill course by Mr. A. J. L. Grimes.

The first year's course has been arranged by the College authorities as most suitable for both engineer and telegraph students. The following remarks apply only to the second year's course as specialised for telegraph students.

The theoretical course appears hardly open to improvement. The physics course, irksome as it may be to the student, and unnecessary as it may at first appear on first joining, is a most valuable course which an officer will probably never have the opportunity or the leisure to obtain afterwards.

The course of pure mathematics is a training which will enable him to read professional books, which would otherwise be closed to him.

The course of applied mechanics has a directly practical bearing on the construction work which the officer will have to perform. A knowledge of applied mechanics underlies all good construction work.

Chemistry up to the standard taught at the College may be useful to a telegraph officer, but the individual will probably specialise more or less in one of these branches, and, while being competent in all, will become more or less either an electrical or a construction engineer.

The practical portion of the course appears open to modification so far as the telegraph construction taught is concerned, in order to bring it more into line with existing practice in India.

It is stated that Douglas' "Telegraph Construction" is still in use, but that excellent text-book by Preece and Sivewright is also read. The Indian Telegraph Construction Code would also probably be useful, and the College might also be supplied with a few tubular posts, brackets, and insulators of the various patterns in use, together with a few coils of wire (the properties of which would be explained), so that the students would actually handle and learn the names of the materials with which they will hereafter have to deal. If time permitted, perhaps a rather longer line (which would admit of examples of angles as well as terminals) might be erected. Perhaps it would be possible to diminish the time spent in workshops practice by eliminating some of the numerous wooden joints and the picture frame. The taking to pieces and reassembling of various instruments would appear to be of more use than the entire making of one new one.

During the course the students have the theory of various circuits and instruments explained. After joining the Department in India, they will use these actually at work in a way which could not be shown in any laboratory. It used to be customary for the students during their last term to be taken to the

General Post Office, Telegraph Office, and Siemen's Works at Charlton, and to write a report on each.

A. J. L. GRIMES,
Superintendent of Telegraphs.

Barrackpur,
The 14th March 1899.

Annexure 3.

Note on Cooper's Hill Course by Mr. M. G. Simpson.

The electrical part of the present course, excellent as it is in many respects, does not seem to impart a really practical working knowledge of the subject. The text-book from which they derive their elementary knowledge is a small book by Professor Silvanus Thompson written many years ago, and in which a good deal of space is occupied by statical electricity of very little practical importance. I would suggest that they use Ayrton's Practical Electricity, which is very simple much more modern, and thoroughly practical. The course in the physical laboratory should be made to fit in with the book. Any student with aptitude for experimental work will find plenty of time for additional physical experiments such as they do now. What I wish to emphasise is that the present physical laboratory course is excellent, but not practically useful, whilst if made to fit in with Ayrton's book, it would be equally excellent educationally and have a practical value in addition.

So much for the purely electrical course with only one year's work. I think we must be satisfied with this.

Now we come to an important subject which at present receives hardly any attention, viz., *Practical Telegraphy*.—At present it seems to consist of a little indifferent signalling and the reading of Preece and Sivewright's book. But as they have no instruments the book is more or less crammed and not generally properly assimilated. I think we should supply them with the instruments we actually use, also with the technical instructions. They should then be taught the different circuits, the current required for each instrument, and its proper adjustment. They should learn to test these instruments and also the regular and fault testing of lines by means of an artificial line. At present they know nothing of regular tests and their fault testing is confined to Murray's loop test. A more earnest effort should be made to teach signalling. To find time for this, I think the chemical laboratory course might be discontinued after the first year, also geology and kindred subjects. Pure mathematics should be continued to the end, but applied mathematics should be confined to problems likely to arise in telegraph construction.

M. G. SIMPSON.
Electrician, Government Telegraph Department.

The 14th of April 1899.

Addendum.

They are not taught anything about telephones, which is an omission.

M. G. SIMPSON.

Annexure 4.

Note on Cooper's Hill Course by Mr. M. A. Thompson.

I do not know how far the above course has been altered since I left Cooper's Hill, but from Mr. Nigel Jones' note I see that some changes have been made. In writing I will only refer to the course I went

through myself. The first year is the same for the Public Works Department as for us; I think that this is as it should be and all the Mathematics, Science and Engineering, the three branches into which the course is divided, are useful and essential. The survey work, especially chain survey, chain and compass traverse check levelling and preparing level sections are useful. At the end of the third term of the first year surveying with the theodolite is commenced, but the telegraph students do not continue this in the second year. I think a little "contouring" might advantageously be added as it would come in very useful in the construction of hill lines. The engineering taught is chiefly of the kind known as "descriptive," and personally I should be very sorry to be in charge of any engineering work of which I only knew, from a description, how it was to be carried out. The telegraph course in the second year as regards construction is also mainly descriptive, and the description does not apply to India at all. We are told to read certain sections of Douglas' Telegraph Construction and are given an examination in it. The practical work consists in putting up a three larch post line. It would certainly be a very great improvement if our construction codes were supplied for instruction with a few of the actual stores and tools used out here. We are taught nothing of spans across rivers, with the exception of a little in the applied mathematics course on the catenary, in which great importance is laid on the strict mathematical formula of the catenary, and the approximate formula is just given and its appplications not explained. Balancing spans appear to be unknown. In the second year's workshops course we start on a number of joints used in roofing and making furniture; this, I think, might with advantage be curtailed; then follows a course of turning wood and metal and working metal, all very practical and useful. We are taught to make Siemen's twist joint and the Britannia joint for telegraph line. In soldering these, however, we use a spirit lamp and after heating the wire apply the solder, a method expressly forbidden in the Construction Code. The importance of using as little heat as possible in jointing H. D. C. and steel wire are not pointed out to us.

The lectures on physics during the second year are the same as for the Public Works Department men and, I think, might be much improved. The lecturer carries out a number of experiments such as measuring electro-motive force by different methods, but as a rule the telegraph men have measured electro-motive forces by these same methods with their own hands in the laboratory, and the lectures naturally have no attraction for them. All the physical laboratory work is excellent. I would suggest that the men be taught to measure the insulation resistance of a cable by the reflecting galvanometer, and a little might be told them of the "electrification curve." The method of measuring the insulation of a cable taught us was Lord Kelvin's with a quadrant electrometer, of which instrument we possess one damaged specimen in a cupboard in the Electrician's Office.

Mathematics is divided into *pure* and *applied.* A subject known as "mechanics applied to construction" comes under the head "Engineering." The mathematics course is excellent both first and second year's. The mechanics applied to construction might well be curtailed, all that I think we need to know being the chief co-efficients such as Young's modulus, Poncelet's co-efficient, and the effects of a strain exceeding the elastic limit on a bar of metal, &c. The calculation of tensions and compressions in the members of a roof frame and of a bridge girder, I cannot see of what use they can be to us. The course in the mechanical laboratory is, I think, indispensable, as it teaches the methods by which the breaking strain and the elastic and other co-efficients of a sample are obtained.

The training in signalling, I think, chiefly stands in need of a change. One hour's practice a week in the physical laboratory and unknown quantity in our own rooms, I think, is quite inadequate. The instruments used are two inkwriters (the relays and inkwriters are on one base board) and two sounders. These instruments are year after year pulled to pieces and put together again by the inexperienced student, and they cannot be satisfactorily adjusted. Two or more Siemen's sounders of 30--Oresistance each might be supplied for signalling practice. I think the plan of having our rooms connected is not a good one. Practically we are expected to teach ourselves signalling

which leads to very bad style being acquired. I think some proper trainer should superintend signalling practice and we should practice signalling the alphabet, counting time for dots, spaces and bars, until we are able to send correctly without counting. Then would be quite time to try fancy signalling. I erroneously thought the chief thing necessary was pace, and after a lot of practice thought my rate was at least 20 words per minute, and was horrified to see that my net rate at the examination at the end of the second year was only a little over 11 due to bad spacing.

I think parts of the Traffic Code might with advantage be taught during the course, and certainly the present course of accounts should be completely done away with, as they consist of nothing but mercantile accounts and are quite a waste of time. I should say that the rules in the Telegraph Guide, with the elementary parts of the Traffic Code directly referring to them, might be usefully taught.

As to the advisability of a year at one of the large telegraph works it is very difficult to speak. Some might derive much benefit from it and others use it as an opportunity to forget what they had learnt. The present President of Cooper's Hill has abolished the practical course for engineering students, and possibly he might have some objections to the introduction of one for the telegraph candidates. Never having been through such a course myself I cannot say of what value the experience gained may be.

In conclusion, I would suggest that a Committee be held in Calcutta in the cold weather, at which definite proposals could be made and adopted as to what the course should be, and a curriculum be drawn up and sent to the authorities at Cooper's Hill to amend and return to us before it goes to the India Office, or wherever it may be, for final decision.

The 5th of June 1899.

M. A. THOMPSON,
Assistant Superintendent of Telegraphs.

APPENDIX 13.

LETTER from Colonel PENNYCUICK to "Engineering," dated 3rd September 1899, as published in the Cooper's Hill Magazine.

"SIR,—Your article on 'the Presidency of Cooper's Hill College,' in your issue of the 1st instant, shows such a misunderstanding of the causes which have led to my resignation that I think it well to let you know the actual facts, though I cannot help remarking that it would have been better had you ascertained these, as you could easily have done by a reference to me, instead of basing an article on an entirely erroneous conjecture.

"As a matter of fact, my resignation had absolutely nothing to do with the question of the amalgamation of the offices of President and Professor of Constructive Engineering, nor is it the case that I have 'failed to carry out my undertaking with the India Office.'

"I never anticipated, and have never experienced the smallest difficulty in carrying out the duties of professor of engineering, but two years' experience showed us that the combination of those duties with those of the President, though not impossible, was undesirable in the interests of the College, as they were constantly clashing; and though I was perfectly prepared to carry out the agreement under which I had accepted office, I thought it advisable either that the separate post of Professor of Engineering should be revived, or that I should be given an assistant to relieve me of some of the routine work *of the President.* I had a strong preference for the former alternative. My recommendation was officially accepted, and so far there was no difficulty or difference of opinion whatever.

"When the late Professor of Surveying retired in July 1898, I proposed a slight redistribution of work, which would result in a small saving of expenditure. The Secretary of State, contrary to my advice, decided on the abolition of the professorship of surveying and the appointment of a single professor of engineering construction and surveying, with an assistant for engineering and one for surveying, an arrangement actually more costly, and for reasons which will be patent to anyone familiar with the Indian Public Works Department, incomparably less efficient than that which I had recommended, and which, owing to the great delay in dealing with the matter, has actually been in force for the last year, with the very men whom I had recommended to fill the posts in question, and has worked most satisfactorily.

"The arrangement actually adopted, though absolutely bad in itself, might have been made to work properly if proper men had been selected to work it, but when at the end of the session just completed, after more than a year's delay, the Secretary of State appointed as Professor of Engineering and Surveying a gentleman who, though of undoubted ability, did not possess the practical experience necessary for the post, I declined to be a party to a measure which I consider inimical to the interests of the College, and of the department for whose benefit it exists, and which at the same time inflicts a scandalous injustice upon two able and valued members of the College staff, and have therefore resigned.

"So much for the facts; may I be allowed to add a few words upon points which are rather matters of opinion.

Although I think it undesirable that the President should hold the position of professor in a particular branch, I do think it very desirable that he should take an active share in the teaching, and I have, as a fact, done this, and should have continued to do so had I remained here.

"I entirely agree with you that the presidency should not be looked upon as "the rightful property of the Royal Engineers," nor, as a matter of fact, has it been so; you are not perhaps aware that one distinguished civil engineer, who was a candidate for the post in 1896, withdrew his candidature when he found that the posts of President and Professor of Engineering were

to be combined. What is necessary is that both of these posts should be filled by men who have had experience in the Indian Public Works Department, and for the former post should have high administrative office in that department, *i.e.*, the chief engineership of a province, or of a large railway. Whether or not they have *in addition* held a commission in the Royal Engineers is a matter of indifference, but at all events such a commission need not be held a disqualification.

"Your remarks show a curious misunderstanding of the real work and position of Royal Engineer officers in the Indian Public Works Department.

"As regards the scientific side, the mathematical training at Addiscombe was, and at Woolwich and Cooper's Hill is at least equal to that at any other institution at which engineers are trained. In my day at Addiscombe it was even more important than it is now, mathematics counting twice as many marks as any other subject. Personally, I may add that it was my own strongest subject, and that I have always kept it up.

"And as to the practical side, can you venture to say that a man who has been for upwards of thirty years employed on purely civil engineering work, who has carried out works of every degree of magnitude, who has received the Telford medal from the Institution of Civil Engineers, and has been for five years the chief engineer of an Indian province 'has nothing to do with the work for which the engineering college is designed'? Surely such a statement carries its own refutation.

"Your suggestion that the duties of President should be performed by a committee shows that you do not realise the intensely personal nature of much of the President's work. This is not only a teaching institution, but a residential college, and the personal interest of the President in, and his influence over, each individual student is of the utmost importance, and forms, in fact, by no means the least serious portion of his work.

"Such work as this, which does not exist in an ordinary teaching institution, could not possibly be done by a committee, but must be done by an individual, and (to be done properly) by an individual of decided interest in and sympathy with the ideas and feelings of young men.

"In two places you speak of service in India in a tone which implies that it is a disadvantage to the President of such a College as this. So far from this being the case it is the one primary and all-important qualification; this College exists chiefly for the supply of recruits to the Indian Public Works Department, all other objects being subordinate thereto, and service in that department is absolutely essential to efficiency in either the President or the Professor of Engineering; the conditions of work in India are so different from those in England that experience in the latter is of very little use as a qualification for training young men for the former.

"I quite agree with you that the President of this College should not be either 'a mere accountant or a military martinet.' I do not think anyone who knows the history of the College during the last three years will charge me with being the latter, and it is because I refuse to accept the position of the former that I am now resigning my post as President.

"You speak of the 'cost of the College to the Indian Government' and of the absence of favour with which it is 'regarded by the civil members of the profession in this country.' Are you aware that for the last three years the College has had a *surplus* revenue of from 1,000*l.* to 3,000*l.*, and that in spite of the disfavour (which I think is more imaginary than real) of the profession, we had at the last entrance examination 70 candidates for 40 vacancies, while every single man who has obtained the College diploma during the last three years has obtained good and well-paid employment within six months after leaving the College, and in most instances, much less time. For the men who passed out at the end of July (less than six weeks ago) such employment has been already secured for almost every one of the 33 men who obtained their diplomas, as well as for one or two who failed to do so.

"Yours faithfully,
JOHN PENNYCUICK."

"Cooper's Hill, Englefield Green, Surrey,
3rd September 1899.

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APPENDIX 14.

LETTER from PROFESSOR HEARSON to the "Engineer," dated 12th March 1901.

SIR,

REFERRING to your leading article on Cooper's Hill last week, no one can be surprised that, after the perusal of 68 pages of misrepresentation afforded in the Blue Book which has just been presented to Parliament, you should have written as you have done. But I appeal to your sense of fairness to allow one who is intimately acquainted with the inner workings of the College to present a sectional view of it, and to ask your readers not to be deceived by the perverted outside view which has been shown in the official report. I appeal to you to let me be heard, not for the sake of my own reputation, but in the interests of a college which, as thousands will testify, has done great good work towards consolidating the power of our Empire in India, and in making our rule there a beneficent one.

By reading the Blue Book you have been led to believe that Cooper's Hill is unpopular, that the instruction it affords is inefficent, and that its cost of maintenance is a not inconsiderable drain on the finances of India.

Now the true facts are entirely contrary. In the first place the number of applicants for entry has been steadily increasing, and has permitted the entrance examination, bit by bit, for several years to be stiffened, whilst at the same time the College has been yearly filled by eligible students. For the proof of the efficiency of the teaching I submit the fact that all our students who reach the qualifying standard—and less than ten per cent. who complete the course fail in this—are almost immediately given good appointments. The Indian Government has the pick of the men to fill the public work appointments, and the remainder are sought for by other Governments or find employment in other departments of our own Government and in private enterprises.

In addition to this very practical evidence of efficiency, I may mention that, whilst our students who gain the higher diploma are exempted by the Institute of Civil Engineers from passing their examination for qualifying as Associate Members, others lower on our examination list, who in the midst of their college work have undergone the Institute's examination, have qualified almost without exception.

On the financial question the Blue Book is significantly silent as to the facts after the year 1895, but even for the nine years which preceded that date, Appendix B, page 13, shows that the total cost of educating all the engineer and forest officers for the Government of India amounted to only 920*l.* a year; whereas the same appendix shows that in previous years, before the Forest School was instituted at Cooper's Hill, the education of the forest officers alone cost the Government 2,200*l.* annually. If the figures for the flourishing years which have succeeded 1895 up to the present time were published, I am certain they would show a substantial balance to the good, and if to that is added the amount which the forest education previously cost the Government, and which has since been saved, the surplus would be sufficient to pay good interest on the capital sum which is invested in the Cooper's Hill estate. You, Sir, quote for some members of the staff certain numbers of lecture hours per week, and it is true the Blue Book has led you to infer that this represents the sum total of the work these gentlemen have to do. It is just about as true as if it were said that the number of hours per week during which your staff is occupied is only equal to the time spent in printing your weekly issue. Again, on the authority of the Blue Book, you have stated that the third-year students have but 14·4 hours of work per week.

I am certain that I am not overstating when I assert that the least industrious student puts in thirty-six hours, and the hard-working students

half as much again. From an extensive experience as to what is done in other colleges, I am convinced that our competitive system compels our students to work harder than in most other colleges, unless they are content to fall hopelessly into the rear, and that the tail of our classes is much smaller relatively to the body than anywhere else.

Mr. Benton, an estimable product of Cooper's Hill, is quoted; but his authority is much abused by claiming it in support of the new curriculum, according to which mathematics occupies so much time in the third year as to practically elbow out the subject of applied mechanics, which has done so much towards making the reputation of Cooper's hill.

You naturally, as so much was made of it in Colonel Ottley's Report, dwell on the so-called laxity with respect to examinations, and repeat that in one case the examination papers were actually sent to a student at his home. The indulgences in this way have been very exceptional. They were allowed only on the condition that the student retired from competition for appointments. They were granted by the ruling of one previous President only, and probably would not have been permitted if the teaching staff had been allowed to decide. This brings me to your statement that the management of the affairs of the college has been in the hands of the staff for many years. That it has not been so is the bottom cause of all the present mischief. Principal Oliver Lodge sets forth the naked truth of this glaring blunder in the *Times* of 20th February, where he writes, "The "Indian Government has attempted to run the college on military and "autocratic lines, and though it had eminent educational specialists among "its professors, it has not attempted to consult them or form them into a "senate or a responsible board of studies or give them any voice in its "management."

That we have been able to do such good work as we have done in the past is due to the respect for the staff which previous Presidents have maintained; but the pages of the Blue Book show that with the advent of a new President this respect has suddenly ceased.

It will perhaps hardly be credited, but it is none the less true, that the proposed drastic changes will result in no diminution in the number of the teaching staff, and not a penny will be saved in the cost of maintaining the College, both of which have been described as being so excessive as to require these changes to be made even at the cost of hardships to individuals. Whatever happens, a grievous blow has been struck at the prestige of Cooper's Hill College, and by those who should have protected its interests. The motive for presenting such a misleading account has been to attempt to justify an action which has roused the indignation of the *élite* of the educational and scientific men in the country. For the mere purpose of making it appear that this untoward action was wise, the India Office has allowed the sacrifice of the College itself, which has had for 30 years a successful and honoured existence. Only in July 1896 Lord George Hamilton, in a long speech of eulogy, said, "It was largely due to the enterprise and training of the officers of the Public "Works Department that Indian finance was gradually assuming a more "satisfactory aspect."

I, as a public servant, may be technically wrong in writing this letter, but I feel that my last effort, after seventeen years of zealous work for Cooper's Hill, cannot be more wisely directed than in appealing for an inquiry into the real truth about a College the success of which I am proud to have had, in association with able and devoted colleagues, a not unimportant share in helping to forward.

T. A. Hearson,
Professor of Hydraulic and Mechanical Engineering.

Cooper's Hill,
12th March.

No. 4.

LETTER from the SECRETARY OF STATE FOR INDIA to the PRESIDENT, Royal Indian Engineering College, dated India Office, 30th March 1901.

AT the request of the Secretary of State the Board of Visitors of the Royal Indian Engineering College have taken evidence from the members of the teaching staff of that College upon the proposed changes in the curriculum suggested by the President, and they have embodied their conclusions, with regard to those proposals, in a report, which has been under the consideration of the Secretary of State in Council, and to which he has given his approval.

2. The report confirms their previous expression of opinion as to the necessity for changes in the course of instruction which in recent years has been carried on at the College. These changes will require the retirement of Messrs. McLeod, Hearson, Heath, Shields, Reilly and Hurst.

3. The pensions and gratuities sanctioned for these gentlemen in Sir Horace Walpole's letter of the 15th January 1901 will be issued to them with effect from the 4th April.

4. In view of the further recommendation submitted by the Board of Visitors that the instruction in physics, which has hitherto been restricted to the first and second year students, should be extended to the students of the third year, it has been decided that Mr. W. N. Stocker shall, for the present and until further experience has been gained, be retained as Professor of Physics. The contemplated developments in the teaching of electric engineering render it possible that the new Lecturer in Electro-Technology may not be able to devote a sufficient portion of his time to the teaching of physics.

5. It must, however, be understood that Professor Stocker can no longer be responsible for or connected with that Department of the College which includes electro-technology. He will take up such a position in relation to the Lecturer in this branch as you may assign to him.

6. You will communicate the purport of this letter to each of the gentlemen concerned.

I am, &c.
(Signed) A. GODLEY.

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EAST INDIA (ROYAL INDIAN ENGINEERING COLLEGE).

Remodelling of Course of Instruction and Retirement of certain of the Professors and Lecturers.

REPORT

OF THE

BOARD OF VISITORS

(Dated 25th March 1901),

AND

MINUTES OF EVIDENCE TAKEN BEFORE THEM.

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EAST INDIA (ROYAL INDIAN ENGINEERING COLLEGE).

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IN REGARD TO THE

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Presented to both Houses of Parliament by Command of His Majesty.

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(*e*) That Cooper's Hill College does not as an educational establishment pay its way, much less any interest on its first cost. The receipts and expenditure can only be made to balance by crediting the College with fees in excess of the actual cost for testing materials for Indian Railways.

(Signed) C. H. T. CROSTHWAITE.
W. S. S. BISSET.
W. H. PREECE.
C. P. ILBERT.
JAS. MANSERGH.
J. WOLFE BARRY.
A. M. RENDEL.

DISSENT by Mr. H. Leonard, F.S.A.

I think that as a "Board of Visitors," we are moving altogether outside of our duties in pleading for the closing of the College. The letter forwarded to me by the Secretary of State when I was appointed a member of the Board lays down the duties thus :—"The object of the appointment of a Board of "Visitors is to provide a highly qualified authority to supervise, in communi-"cation with the President of the College, the course of study to be "pursued there, and to advise as to the internal management of the College." In the face of these instructions, and as a member of the Board, I cannot see how I can be a party to an attack of this kind on the College, whether I agree or do not agree with the arguments put forward in the letter. I think it is not for me, as a Visitor, to advocate the closing of the College without having been called on by the Secretary of State to give advice on the subject. I must therefore decline to sign this letter.

(Signed) HUGH LEONARD.

1st April 1901.

No. 2.

LETTER from the Under Secretary of State to the Chairman of the Board of Visitors, dated India Office, 7th May 1901.

I am directed by the Secretary of State for India in Council to acknowledge the receipt of the report, dated 1st April and signed by yourself and by a majority of the Board of Visitors, in which you recommend that, before entering on certain matters which his Lordship has promised to refer to a committee of your Board, the arguments against the further maintenance of the Royal Indian Engineering College should be carefully examined.

You proceed to state those arguments, and I am directed to say that they have been carefully considered by his Lordship in Council. and that he fully recognises their strength and importance. Nevertheless, he is not disposed at the present moment to raise the question of the abolition of the College.

2. You are aware that in 1895 a Committee of which you were Chairman, placed before him somewhat similar reasons for abandoning the attempt to maintain a special place of education and training for the Indian Public Works Department. His Lordship, however, after careful consideration and some doubt, decided to carry the experiment further, and to endeavour to reform and widen the system of education and generally to improve the working of the College. Various measures were adopted with this object, and a certain amount of success was achieved. The last and most important step was the complete remodelling of the course of study upon a plan recommended by Colonel Ottley, and approved by your Board. This reform

is now about to come into force, and his Lordship is very unwilling, at this moment, to adopt a proposal which would certainly have a most discouraging effect upon the Staff of the College, and would prevent the policy, which has so recently been re-affirmed by his Lordship in Council, from being fairly tried.

3. Lord George Hamiliton is inclined to believe that if the College is maintained, it will be possible, under the conditions now existing, to provide there a system of training which will be specially valuable and appropriate for students who look forward to an Indian career, and which cannot be obtained in any institution or place of education wholly unconnected with India.

4. Under these circumstances, his Lordship considers that the present is not an opportune occasion for opening a discussion on the question of the abolition of the College, and he proposes to proceed with the inquiry which he has promised to hold on the constitution and working of the College. He will, however, not lose sight of the arguments which the majority of the Board of Visitors have placed before him, and will regard the maintenance of the College in the light of an experiment, the continuance of which can only be ustified by its success.

I am, &c.,
(Signed) HARDWICKE.

No. 3.

LETTER from the Under Secretary of State to the Chairman of the Board of Visitors, dated India Office, 17th May 1901.

I am directed by Lord George Hamilton to request that the Board of Visitors of Cooper's Hill College will be good enough to nominate a Committee to inquire into and report upon the working, discipline, and constitution of the College and the relations of the Visitors, the President, and the Teaching Staff.

2. His Lordship suggests that the Committee shall not consist of more than six members, and that it should, in accordance with the undertaking given in his letter to Sir William Anson of the 11th March, include the three representatives of the Universities of Oxford, Cambridge, and London, who have been, or are about to be, nominated.

3. I am to explain, in case any doubt on the subject should arise, that the terms of reference are not intended to include any inquiry into the course of study pursued at the College, or into the methods of teaching. These matters have lately been very fully and exhaustively considered and decided upon, and his Lordship does not propose to re-open the subject. He therefore hopes that the Committee will confine their attention to the constitutional machinery by means of which the government of the College is carried on, and discipline enforced, and that they will make any recommendations for the improvement of its practical working which the result of their investigations may suggest to them.

4. His Lordship requests that the Committee will submit their Report to the Board of Visitors, who will pass it on to the Secretary of State with such observations as they may think fit to make upon it.

I am, &c.,
(Signed) A. GODLEY.

No. 4.

Report by the Board of Visitors to the Secretary of State, dated India Office, 19th July 1901.

In Sir A. Godley's letter of the 17th May 1901 to the address of the Chairman of the Board of Visitors, Lord G. Hamilton requested the Board to nominate a Committee to inquire into and report upon the working, discipline, and constitution of the College and the relations of the Visitors, the President, and the Teaching Staff. It was suggested that the Committee should not consist of more than six members, and that it should, in accordance with the undertaking given in his letter to Sir William Anson of the 11th March, include the three representatives of the Universities of Oxford, Cambridge, and London, who had been, or were about to be, nominated.

The Board were also informed that the terms of reference were not intended to include any inquiry into the course of study pursued at the College, or into the methods of teaching, these matters having lately been very fully and exhaustively considered and decided upon, and his Lordship did not propose to re-open the subject. He therefore hoped that the Committee would confine their attention to the constitutional machinery by means of which the government of the College is carried on, and discipline enforced, and that they would make any recommendations for the improvement of its practical working which the result of their investigations might suggest to them.

In pursuance of these instructions the Board met on the 4th June and elected the following members to serve on the Committee, viz. :—

Sir C. H. T. Crosthwaite,
Sir C. P. Ilbert,
Sir J. Wolfe Barry,
Dr. A. R. Forsyth,
G. C. Bourne, Esq.,

and Sir W. H. Preece pending the nomination of a representative of the University of London.

Subsequently Sir E. Busk was nominated to represent the University, and, with the consent of the Secretary of State for India, Sir W. Preece continued to serve on the Committee.

The Committee have conducted the enquiry confided to them, and have submitted a report to the Board, which is enclosed herewith.

In forwarding the Committee's Report, the Board of Visitors desire to express their concurrence with the recommendations of the Committee and with the Memorandum signed by the University representatives on that Committee.

The Board desire to invite the careful attention of the Secretary of State to the important expression of opinion embodied in the concluding sentence of the Memorandum, an expression of opinion which appears to the Board to confirm and emphasise the recommendations made in the letter addressed by a majority of the Board to the Secretary of State on the 1st April last. The large expenditure which the Committee regard as necessary for the efficient education of the students, without providing for an increase in their number, gives urgency to the questions raised in that letter.

Mr. Leonard, however, desires to reserve his opinion on the question raised in the concluding sentence of the University members' Memorandum.

(Signed) C. H. T. Crosthwaite.
A. M. Rendel.
W. H. Preece.
C. P. Ilbert.
Hugh Leonard.
W. S. S. Bisset.
G. F. Pearson.
J. Wolfe Barry.
A. R. Forsyth.
G. C. Bourne.
Edward H. Busk.
J. G. H. Glass.

Absent.—J. Mansergh.

No. 5.

REPORT of the Committee of the Board of Visitors to the Board of Visitors, dated India Office, 12th July 1901.

We, the members of the Committee nominated by the Board of Visitors in accordance with the request made by the Secretary of State in his letter of 17th May 1901, having inquired into the working, discipline, and constitution of the Royal Indian Engineering College, and the relations of the Visitors, the President, and the Teaching Staff, desire to make the following report for the consideration of the Board of Visitors. Subject of the Inquiry.

As the terms of reference exclude from the scope of our inquiry the course of study followed at the College and the methods of teaching, we have not touched upon these matters except in so far as was necessary for the elucidation of the subjects referred to us. We have also refrained for similar reasons from discussing the question which, in the opinion of some members of the Committee, would have been the first matter for consideration, namely, whether the maintenance of the College is any longer necessary or desirable as the best means of obtaining men for the Indian Public Works Services.

In order to make this report and our recommendations fully intelligible to all, it is necessary to give a brief account of the history of the College,* and of the present system of governing and administering the institution. We have endeavoured to ascertain these matters from the records and from the witnesses who have been examined by us. Origin of the College.

The Royal Indian Engineering College was founded in 1870 by the Duke of Argyll, the then Secretary of State for India, and was opened in 1871. There had arisen at that time in India a demand for Engineers, owing to the impulse given to railway construction and other public works; and the Government of India found a difficulty in obtaining a sufficient number of trained Engineers of the type they wanted in the open market. It was determined to create a special service for India, to obtain recruits by open competition, and to train them in a technical school under Government control. For this purpose Cooper's Hill College was established. The competition for appointments was at the entrance, and all the students were probationers under training for India.

If the forecast of the Government of India as to the number of recruits (forty) annually required had proved correct there would have been no room for any other class. Very soon, however, owing to financial difficulties and other causes the indents from India for Engineers were much reduced. It was found that only about twelve men in each year would be needed. Consequently the number of persons coming forward to compete for the appointments fell off. In 1880 it was decided to receive, so far as the accommodation in the College permitted, such persons as desired to study Engineering, and could pass the entrance examination, but had no intention to enter the Indian Service. The assignment of Indian appointments among the students was put off until the final examination.

The *raison d'être* of the College has, notwithstanding, remained the same. It exists for the purpose of preparing students for the service of the Public Works Department of India, and that fact has moulded its character in the past, and must continue to govern it in the future.

The constitution of the College we find authoritatively laid down in a minute approved by the Secretary of State in Council, dated 28th July 1870. It may be summarised as follows:— Constitution of the College.

The organisation contemplated was, "on the basis of the Colleges at the English Universities."

The staff consisted of a President, assisted by 11 Professors and Instructors. There were also a Bursar, a Secretary, and a subordinate establishment.

The sole responsibility for the discipline and management of the College and for the general superintendence of the studies was vested in the President, who, with the approval of the Secretary of State, was to have "the power of appointing and removing the Professors and Instructors." He was to be assisted in "the arrangement of the studies by a College Board, composed

* *Vide* Parliamentary Papers, 23rd March 1871, Nos. 115 and 148.

"of the Professors of the principal branches, with whom he should from "time to time confer on the matters relating to their branches. He should "also from time to time during each term call together the whole body of "the Instructors and take their opinion on matters connected with the general "interest of the College."

The Professors were to be appointed for a term of five years only, which might be occasionally, though not usually, extended. In a subsequent minute dated 10th February 1871, the Secretary of State in Council decided "that the limitation of five years should be abandoned, and that the "Professors should be engaged during pleasure, with a stipulation that "the engagement may be terminated by six months' notice on either side "without reason assigned." It was also ruled in the same minute that the Professors be considered as entitled to pension in due course under the same conditions as other servants of the Crown.

As regards the students, the President was given the power of rustication, but dismissal from the College was made subject to the approval of the Secretary of State.

An inspection was to be made at least once a year by a Visitor or Visitors appointed by the Secretary of State, and reporting to him.

In its broad features this constitution has continued to the present day, but in practice various modifications have been introduced, which may be conveniently described in dealing with the constituent parts of the system.

The Governing Body.

Being a Government institution established by the Secretary of State for Indian purposes, and dependent for financial assistance on the Indian revenues, the control of the College from without has been exercised necessarily by the Secretary of State for India in Council. The following statement of the relations of the Secretary of State to the College has been communicated to us by the India Office:—

The Secretary of State for India.

"The relation of the Secretary of State in Council to Cooper's Hill College closely resembles that of a Governing Body under the Public Schools Act, 1868, to the public school which it governs. All the property of the College is his; he appoints, and, if necessary, dismisses the President; and the authority of the President and of every one else at the College is derived directly or indirectly from him.

"This being so, it is obvious that his control, and therefore his responsibility, must be complete. But, recognising the fact that he has no special qualifications for the management of a place of technical education, his policy is to delegate his authority as far as possible, to keep in the back ground, and to interfere only when some matter is referred to him by the President, or when he is appealed to by some person who has a claim to be heard by him. For the same reason he has appointed a Board of Visitors, selected for their special qualifications, to advise him on such matters connected with the College as he may refer to them.

"In all matters of College discipline his policy is to select as President the best qualified person whom he can find, and, having done so, to leave him the widest possible discretion, to treat him with confidence, and to support his authority. With the details of College management he desires to have as little to do as may be. But, as he is responsible to the public for the acts of his officer, he is obliged to have it understood that any new or exceptional measure, or any measure which for one reason or another is likely to be publicly challenged, is, if possible, to be referred to him before being adopted.

"In matters relating to the general management and administration of the College, his policy is to take the advice of the Board of Visitors, who possess the special and technical knowledge which he does not pretend to have, and to act upon it; though here, again, he cannot shake off his responsibility, and must therefore consider each question, as far as he can, upon its merits.

"It will be seen, therefore, that his wish is to have the College managed, as far as may be possible, without his intervention; and, when his intervention is required, to rely mainly upon the advice of the President in matters of detail, and of every day administration, and upon that of the Board of Visitors in important matters and questions of general policy.

"Those who are acquainted with the working of a public school will see that this statement bears out the comparison between the position of the Secretary of State and that of a governing body. Such difference as there

is results mainly from the fact that (1) the Secretary of State, being a public functionary, is more liable to observation and attack than an ordinary governing body, and is therefore likely to be more cautious and deliberate in his action, and to insist more strictly upon having previous knowledge of any important measures that may be contemplated; and that, (2) in consequence of the technical and special knowledge required for the proper conduct of the College, he has appointed a Board of Visitors, not to relieve him of his responsibility, but to act as his advisers as to the working and requirements of the College from the point of view of an independent authority."

The Board of Visitors.

It has been seen that in the original constitution of the College, the appointment of a Visitor or Visitors to inspect the College at least once a year and report to the Secretary of State was contemplated.

The appointment of a Board of Visitors was determined upon in 1880, when it was decided to throw open the College as a school of instruction for the civil engineering profession, and to grant appointments in the Indian Public Works Department on the cumulative results of the College course, instead of, as previously, at the commencement.

The Board was to consist of a chairman, four civil engineers, and four gentlemen specially connected with India.

Addressing Sir Richard Temple, the first Chairman, the Secretary of State described the object of the appointment of a Board of Visitors as "to provide "a highly qualified authority to supervise, in communication with the "President of the College, the course of study to be pursued, and to advise "as to the internal management of the College."

So far as we can discover nothing further was laid down regarding the duties of the Board of Visitors, nor were any detailed instructions given to them, and there was no fixed time or place for their meetings. Reports were submitted by them to the Secretary of State on matters connected with the College in 1882, 1886, 1892, 1895, and in 1897. For many years their action appears to have been chiefly confined to a formal annual visit to Cooper's Hill. Their advice does not seem to have been asked on matters connected with the internal management of the College, which were dealt with by the Secretary of State in communication with the President and without the interposition of the Board. The gentlemen originally composing this body had been appointed for no definite term, and for some years, at any rate prior to 1896, the Board's duties had become of a formal and almost nominal character. Since that year there has been a new departure. The Chairman and several of the older members having retired, the Chairman of the Public Works Committee of the Council of India was appointed in 1897 to be *ex-officio* Chairman of the Board of Visitors, and it was laid down that members of the Board should vacate their seats after five years. Several new members were nominated, and the policy of referring to the Board important matters relating to the administration of the College and the curriculum of studies was more consistently followed. During the last few years the references to the Board have been frequent. They have met at the India Office to discuss important questions, and, at the request of the Secretary of State, they have conducted, on a late occasion, a lengthy and somewhat delicate investigation. The constitution, however, of the Board has remained undefined; and, so far as this Committee is informed, no rules have been laid down by the Secretary of State in Council regarding the matters to be referred to them. The practice in this respect has, it appears to us, been uncertain. Action has been taken sometimes without reference to the Board, in matters of a kind regarding which on other occasions their advice has been sought. With the appointments either of the President or of the staff the Board have had no concern. Still less have they had any financial responsibility for the management of the College. But once or twice some of the members have been asked to assist in selecting men to fill appointments.

The Board do not correspond with the President of the College, nor are they the medium through which the Secretary of State communicates with the President. The Board, or individual members of it, may in their capacity of Visitors inspect the College, and obtain information from the President. But they lay their recommendations, when they have any to make, before the Secretary of State, who issues his instructions to the President.

The President.

The President, as we have shown, is appointed on the sole responsibility of the Secretary of State. We are not aware of any occasion on which the advice of the Board of Visitors has been sought in selecting a gentleman for this office.

Since the opening of the College in August 1871 four Presidents have held office at Cooper's Hill:—

Colonel (afterwards Major-General) Sir George T. Chesney, R.E., K.C.B., C.I.E.—Appointed on the 24th April 1870, the appointment being for seven years, with power of re-appointment at the end of that term. Salary 1,000*l.*, with house. A personal allowance of 500*l.* a year was granted to him in 1873. Service reckoned for Military Pension.

General Sir Alexander Taylor, R.E., G.C.B.—Appointed 2nd November 1880. No period was specified. The salary granted was 1,000*l.* per annum, and house. No pension.

Colonel John Pennycuick, R.E., C.S.I.—Appointed September 1896. Salary 1,000*l.* (300*l.* as President and 700*l.* as Professor of Engineering) and house. The appointment was to be for ten years, after which time he might be re-appointed at the discretion of the Secretary of State, but would be required to vacate his appointment on attaining the age of 70 years. The appointment carried no pension.

Colonel J. W. Ottley, R.E., C.I.E.—Appointed 11th October 1899. Appointment to be "held during pleasure," and to terminate after ten years. Salary 1,000*l.* and house. No pension.

The relations between the President and the India Office have not materially altered since the institution of the College. The Secretary of State is the supreme authority in all matters connected with the administration and finances of the College.

General financial control is exercised through the yearly budget, which is submitted by the President at the commencement of the financial year, and outside the provisions of which no expenditure is allowed except under special sanction obtained from the Secretary of State in Council.

With the exception of the petty establishment, all appointments and dismissals in the staff have been referred for the previous approval of the Secretary of State.

It should be noted that Colonel Pennycuick was appointed on the condition that he should discharge the duties of Professor of Engineering Construction in addition to those of President, and he accepted office on this understanding. Up to the time of his appointment the President had never taken part in the teaching. In 1894 a Committee was appointed by the Secretary of State to examine the financial conditions of the College, and to suggest methods of economy. This Committee (whose report will be found in a Blue Book* of 1901) advised the Secretary of State to combine the functions of President and Professor of Engineering with the object of saving money, and also of associating the President with the education of the students, on the analogy of the Headmaster of a large Public School. After some two years' experience, however, Colonel Pennycuick represented his inability to do justice to the combined duties placed upon him, and he was relieved from the obligation to teach.

Apart from this temporary alteration the functions of the President have remained as they were constituted at the establishment of the College.

The Teaching Staff and their status.

It has been seen that by the original constitution of the College, the President had "the power of appointing and removing the professors or instructors," but "with approval of the Secretary of State." In point of fact, he was only vested with the power of recommending appointments or dismissals. It appears from Colonel Ottley's statement that this is the present extent of the President's power, although the letters of appointment are so worded as to make the tenure of the posts dependent on the incumbents giving satisfaction to the President.

The Secretary of State has recently conceded to the President the power of appointing and dismissing officers in the position of demonstrators; and it need hardly be said that the President exercises a like power over the

* East Indian (Royal Indian Engineering College) Correspondence, Cd. 490.

ministerial and menial establishments. By the constitution of 1870, the professors were appointed for five years only, with the understanding that the period might occasionally be extended. By a subsequent minute, dated 10th February 1871, it was ordered "that the five years' limit should be "abandoned and that the professors should be engaged during pleasure, with "a stipulation that the engagement may be terminated by six months' "notice on either side without reason assigned."

Apart from the alterations in the salaries which have resulted from the changes made from time to time in the curriculum of the College, the status of the teaching staff generally has been modified in one point only, but that is one of importance. The professors were originally given a title to pensions, under the same rules and conditions as other servants of the Crown. In 1883 it was resolved to discontinue the grant of pensions. At the present time there remain only three members of the staff who, on retirement, are entitled to pensions. Such changes, therefore, as have been made, have not been in the direction of greater permanency of tenure. The difficulty of maintaining a technical college of this kind in a thoroughly efficient state, if the professors and teachers could not be changed without difficulty from time to time, no doubt led to the abolition of pensions. If the retirement of an officer means an addition to the pension list, the financial aspect of the matter leads to his being retained; and it requires very strong reasons to induce a controlling authority to discharge a man from a pensionable post before he has earned his pension. On the other hand, it appears that the five-year limit, which was abolished in 1871, was recognised to be inconvenient.

The College Board.

We now turn to a very important institution, which found a prominent place in the original constitution of the College. The President was to be assisted "in the arrangement of the studies by a College Board composed of "the professors of the principal branches, with whom he should confer from "time to time on the matters relating to their branches." It was also laid down that "the President should from time to time during each term call "together the whole body of the instructors, and take their opinion on "matters connected with the general interests of the College."

There were, then, to be two bodies, one a board of the principal professors with whom the President was to consult regarding the arrangement of the studies of the College. The other was to be a sort of general assembly of all the teaching staff, whose opinion was to be sought on matters of general interest.

It is a curious fact that although the instructions directing the formation of these two bodies are contained in the Minute of 28th July 1870, which had all the authority of an order of the Secretary of State for India in Council, yet they have never, so far as we have been able to ascertain, been strictly obeyed. It does not even appear that this order was ever formally communicated to the President.

In the India Office it appears to have been forgotten altogether. The attention of the Board of Visitors has never been drawn to it. We should not now have known of it had not Professor Minchin produced a copy of the first College Regulations. In the College the original intention of having two bodies, one limited to the principal professors for the direction of the studies, another of a more popular kind for dealing with general interests has not been fulfilled.

If the original design was departed from in the formation of the College Board, it was varied also in the matters which were placed before that body. By the constitution the discipline of the College was entrusted to the President. It seems, from the evidence and from the minutes of the Board's meetings, that matters of discipline and punishment were frequently referred to the Board and discussed by them with the President.

The initiation of business appears to have been in the power of any member of the Board, who could make an entry in an Agenda Book of any matter which he desired to bring forward. The meetings for a good many years past, extending back into Sir Alexander Taylor's term of office, appear to have been held at irregular, and some times at very long, intervals. During Colonel Pennycuick's time they were more frequent, and since Colonel Ottley became President they have again diminished. The following

statement, drawn up from the Minute Book, shows the number of meetings held in each year since 1877:—

Colonel Chesney, President	1877 (two terms)	9
	1878	11
	1879	13
Sir A. Taylor, President	1880	9
	1881	9
	1882	6
	1883	5
	1884	8
	1885	6
	1886	7
	1887	7
	1888	4
	1889	7
	1890	5
	1891	18
	1892	6
	1893	3
	1894	6
	1895	3
Colonel J. Pennycuick, President	1896	3
	1897	9
	1898	8
	1899	9
Colonel Ottley, President	1899	3
	1900	6

The matters discussed at these meetings have been for the most part educational, such as the arrangement of studies, allotment of marks, results of examination, &c., but a large number of the meetings were specially convened to consider cases of breach of discipline.

It is admitted by all that the decisions or opinions of the Board have only carried such weight as the President might allow to them. The Board sat as a consultative body only, and were on several occasions reminded of that fact even by Colonel Chesney and Sir Alexander Taylor, both of whom were, it is said, in the habit of being guided by the advice of the Board. We have had the Minutes of the Proceedings of the Board examined, and an abstract* of some of the cases which were dealt with by them is given in order to show the character of the business with which they have been in the habit of dealing.

General duties and powers of Professorial Staff.

The professors individually have had no concern with the general administration of the College. It has been the custom of the President to allot a certain number of students to each professor, who was in that capacity styled the "tutor" of the students so placed in his charge. We understand that a student could consult his tutor on any matter on which he needed advice outside his studies, and that the tutor was expected to know and to influence the character and conduct of his pupils. Colonel Ottley has substituted the title of "superintendent" for that of "tutor," on the ground that the latter word was misleading as it might be taken to imply that the professor in this capacity assisted or controlled the students in their studies, which was not intended. For any help needed in that direction a student has to go to the professor of the subject in which difficulty is experienced.

The "tutors" or "superintendents" formerly had the power of granting certain kinds of leave to their students. This power has been taken from them by Colonel Ottley and transferred to the Bursar.

The professors as such had certain disciplinary powers, and could punish minor offences by fines or gateing. Colonel Ottley has taken all matters connected with discipline into his own hands.

Enforcement of Discipline.

This leads us to the question of the enforcement of discipline. The present practice, which places it in the hands of the President alone, is in accordance with the constitution of the College.

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* Not printed.

The punishments in use from the first institution of the College, for minor offences, were stoppage of leave, fines, gateing, and arrest. Gateing appears to have been found impracticable owing to the nature of the College buildings, and was discontinued. Before the present President took up his duties, a graduated scale of fines corresponding to the seriousness of the offences was in use, but Colonel Ottley, considering this form of punishment ineffective and objectionable, has substituted a system of marks—a fixed number of marks for conduct being allotted to each student, from which deductions are made for breaches of discipline.

For the more serious form of offences resort could be had to rustication or dismissal. In the few cases in which these punishments have been inflicted the President has usually acted on the advice of the College Board or the leading members of the Staff, and has reported his action subsequently to the Secretary of State for confirmation.

Students. Their parentage.

The students are drawn from the public schools in general, and mainly from the modern side; for the most part they are sons of persons of the middle class in easy circumstances. Their average age at entrance is 19, and this average is slightly on the increase. The annual expenses of a student (*i.e*, during the 37 weeks of residence at the College in each year) are estimated at 275*l*. on the average; the course extends over three years; and the scholarships are trivial in value.

Mode of admission to College.

The principal mode of admission for Engineer students is by an entrance examination, the amount of competition at which varies from year to year; deficiencies in the number thus admitted are supplied on the nomination of the President. In 1900, the total number of students admitted was 36; of these, 27 satisfied the examination, and the remainder were nominated by Colonel Ottley.

Entrance Examination.

The entrance examination is chiefly of a mathematical character. The papers of 1900 in that particular range included arithmetic and easy mensuration, algebra, as far as geometric progression; the first four and the sixth books of Euclid's Elements; the elements of trigonometry, as far as the solution of simple triangles, and the simplest use of logarithmic tables. The prospectus for 1901 indicates a somewhat more extended range in mathematics, and we are informed that it is proposed to extend this range still further. In recent years, drawing has been added. A paper is set in English subjects, and a paper of translations (from Latin, French or German, into English) is also set; but these papers are not regarded as of significant importance. So far as the examination indicates, the men are of ordinary intelligence. Special care is exercised to secure men who are physically fit for the service; but the examination is not of such a character as to ensure the recruitment of men with special intellectual qualifications for the Indian Service.

The only open competition to which the students are submitted is this entrance examination. Moreover present practice would indicate that one quarter of the students admitted in any year have not been submitted even to this test, though there is no reason to believe that any of them would have been rejected at the examination. After entrance, the only competition to which the students are submitted is that of their own rivalry, the results being cumulative through the three years, and in that period they are required to attain some qualifying standard in the various tests adopted.

Number of Appointments.

The number of appointments offered changes from year to year; it is announced in the prospectus of each year issued before the entrance examination. To the candidates in 1900, of whom 36 in all were accepted, it was announced that 33 appointments would be made; so that all but three of the candidates then accepted can look forward to a definite appointment at the end of their three years' course if they reach the qualifying standards.

The posts, to which the men are appointed, are good. Thus, in the Public Works Department, the initial salary is about 280*l*. a year, with travelling allowance; a man can reasonably expect that his salary will rise to 800*l*. a year after 20 years' service at the utmost; and after 25 years' service, he retires on a pension of probably not less than 350*l*. a year. For the best of the men there are better chances, some posts being worth 2,000*l*. a year.

It may be added that, even in the case of the few students who do not receive any of these appointments, opportunities of a similar character in

other services are sometimes offered; a definite statement to this effect occurs in the prospectus of the College.

Forest Students.

Besides the students under training for the Public Works Services, there are a certain number of Forest Students who stand on a different footing. They are selected at an open competitive examination, and are sent to Cooper's Hill to undergo a course of instruction in Forestry. They remain in the College for two years, and are then sent to Germany for a year to study practical forestry, and, unless they fail to pass the qualifying test, they are assured of their appointments. The practice of training the forest recruits at Cooper's Hill began in the year 1885. The Forest Department of the College is, in our opinion, better equipped than any other branch.

Recommendations.

The sketch we have given in the foregoing paragraphs of the past history of the College and its present constitution will, we hope, be sufficient to enable the Board of Visitors to understand the reasons of the recommendations which we now proceed to make.

The Governing Authority.

We take it for granted that the conditions of the case render it unavoidable that the Secretary of State in Council should retain the immediate control of the College in his own hands. The institution belongs to the Government of India, and is maintained solely for the purpose of supplying recruits to the Public Works Service of that dependency; and the capital which established it, and the funds which support it, came and come from the revenues of India. The financial control is, therefore, by Act of Parliament, in the hands of the Council of India. It may be that if the Secretary of State in Council could endow the College, and delegate the management of it altogether to an outside body, its success as an educational institution might be more assured. But an institution so managed could hardly be placed on a satisfactory basis if the number of the students were limited to those required for the needs of India. The tendency of the governing body would naturally be to convert it into a general Engineering College, available not merely for those intending to enter the Indian Service, but for those wishing to seek employment in England or elsewhere. But revenues which are required by law to be appropriated for the purposes of the Government of British India alone could not, without obvious breach of justice, if not of law, be applied to the general maintenance of a college so extended. It is not to be supposed that any Board or Committee which had not the financial control would undertake to govern the College. All authority must therefore remain with the Secretary of State in Council, and all responsibility also must rest on him.

Board of Visitors.

These conditions should be borne in mind when the position and powers of the Board of Visitors, and of the President of the College are discussed. In the controversies that have arisen regarding Cooper's Hill it has not unfrequently been assumed that the Board are in fact the governing body of the College and are responsible for its management. What has already been said in this Report will, it is hoped, serve to clear away any such misconception. It is held by some of those whom we have examined that the Board of Visitors should have executive authority; for example, that any difference of opinion between the President and his staff of Professors should be referred to the Board of Visitors, and that their decision should be final. A desire has also been expressed that the College Board should have direct communication with the Board of Visitors and that members of the staff who may be called on to retire should have the right of appealing to the Board of Visitors for an investigation of the case. It is our opinion that the Board of Visitors must remain a purely advisory body.

This has been their character in the past, and it must be their character in the future; since, as we have shown, they have not, and cannot have, the power of the purse, and therefore cannot be a governing body in the ordinary sense of the word. It is the Secretary of State who has called the Board into existence with the view of getting their advice and assistance, but with no intention of delegating his power to them. It rests with him to consult them or not, as he may think fit, on matters connected with the College; and his practice in this respect has varied. On some matters, as we have already indicated, the Board have been consulted, while on others of a similar nature, but perhaps of greater importance, action has been taken without reference to them. As an example of the

latter, the abolition of the practical course in England, for students who had completed their training in the College, may be cited. Until 1897 every successful student, before he was sent to India, had to spend a year in England on some large engineering work. This practice was altered in 1897 at the request of the Government of India without reference to the Board of Visitors. We recommend that the character of the questions to be referred to the Board of Visitors be defined by a rule passed by the Secretary of State in Council, and that by such means as may appear best to him he shall secure that all questions coming under that rule shall be referred to the Board of Visitors. It is hardly reasonable that they should be asked to advise on matters connected with the studies of the College, if changes in the curriculum may be made without reference to them and even without any intimation of the change being conveyed to them.

Meetings of the Board.

The Meetings of the Board should as a rule be held at the India Office. There should be meetings once a quarter to dispose of such business as may be referred to them by the Secretary of State.

The President.

It will be seen by the statement on page 10 that the President has always been an officer of the Corps of Royal Engineers. We are inclined to doubt the expediency of limiting the appointment to this class, and we consider that it would be desirable, in case of future appointments, to attach weight to educational experience.

In our opinion the provision of the original constitution of the College which vested in the President the sole responsibility for the discipline and management of the College and for the general superintendence of the studies was a wise one. Equally wise was the rule which laid down that "he was "to be assisted in the arrangement of the studies by a College Board, "composed of the professors of the principal branches. with whom he should "from time to time confer on the matters relating to their branches."

The College Board.

We have considered carefully the position which is to be assigned to the College Board. There are two views of the question, for each of which much may be said. It may be argued that the intention was to organise and administer the College "on the basis of the Colleges at the English Universities." In former times the Head of a College at Oxford or Cambridge was often an autocrat, and could, and no doubt did, set aside the opinion of the majority of the Fellows when it so pleased him. At the present day the Head is only *primus inter pares*, and the decision of the majority rules the College. There are some who are inclined to hold that Cooper's Hill should be administered on the later system; and that the decision of the College Board, of which the President would be chairman with a casting vote, should be final on all matters connected with the studies of the College. We have come to the conclusion that it is not practicable to administer Cooper's Hill in this manner. In an Oxford or Cambridge College the majority of the governing body would have the power to enforce and carry into practice the conclusion at which they had arrived, and on them would rest the burden of finding the means to carry it out. But in the case with which we are dealing the conditions are very different. The controlling authority and the power of the purse are outside the College. The Secretary of State is the real head of the College, and the President is his lieutenant, who is bound to carry out his orders and be guided by his wishes in the administration of the College. We do not think it practicable under these circumstances, to give a majority of the College Board final power to overrule the President. At the same time, we think it not only reasonable, but absolutely necessary, that the staff should be consulted with regard to the studies of the College, and all changes proposed to be made in them.

The arrangement that we desire to recommend is this:—

(1.) That there shall be a College Board, consisting of the President as chairman, and of the senior Professors of Engineering, of Mathematics, of Natural Science, and of Forestry; and that this Board of five shall be empowered to deal with all matters connected with the studies of the College.

(2.) That the College Board shall meet regularly once a month, whether any question has been put down for discussion or not, and at any time either

when summoned by the President or on the requisition in writing of two of the members.

(3.) That the opinion of the majority on any matter under discussion shall prevail; but if the President differs from the majority and desires to have their decision reviewed, he shall refer the case for the orders of the Secretary of State.

(4.) That the President or the College Board shall have power at any time to summon a meeting of the whole body of the instructors for consultation on matters connected with the general interests of the College.

Discipline.

As to disciplinary matters, we consider they should be retained by the President in his own hands. There is almost a consensus of opinion, among those whom we have examined, on this point. The President should, however, delegate to the members of the teaching staff such powers as may be necessary to enforce order in the lecture-room and in hall and within the College precincts. We are of opinion, also, that in serious cases which call for the severer penalties, such as rustication or dismissal, he should not act without consulting the College Board, although he need not be bound to accept their advice.

The President's decision should be final, but his action should be reported to the Secretary of State, and in doing so he should state whether his decision has the concurrence of the College Board.

Appointment and dismissal of Staff.

The appointment and dismissal of the superior staff, all, that is to say, above the rank of Demonstrator, should rest with the Secretary of State. We recommend that all appointments should be made during pleasure, and terminable by either side with six months' notice, without any reason being assigned; and we are of opinion that in all cases power should be reserved to make the appointment for a year on probation. The condition at present forming part of the engagement, which makes the appointment tenable so long as the incumbent satisfies the President, is open, in our opinion, to objection, and should be omitted from future letters of appointment.

As to Demonstrators, we think their appointment and dismissal should rest, as has been ordered recently, in the President's hands, but, in selecting a Demonstrator, he should consult the Professor of the subject.

College Regulations.

Regulations for the administration of the College appear to have been originally made by the Secretary of State. The existing standing orders, as re-arranged by the present President, are based on the various regulations which have been approved from time to time.

We would suggest that the Secretary of State should make a few regulations defining the more important features of the constitution of the College. But these regulations should be very general and elastic in their character, and full power should be left to the President to make rules on all minor matters after consultation with the College Board.

The existing standing orders appear to us to be of too military a character and in recasting them we advise that all phrases and expressions which suggest military regulations or discipline should be struck out. The average student at the College is of the same age as the average student at an English University, and the kind of discipline which should be maintained is the same kind of discipline as is maintained at a well-managed College at Oxford or Cambridge. We would restore to the Professors, in their quasi-parental relations with the students, the old title of "tutor," which is well understood at Oxford and Cambridge in this sense, and does not imply any duties of teaching.

All matters of a descriptive and hortatory nature, and all matters which may be taken for granted as incidental to good order and gentlemanly behaviour, should be struck out of the College rules.

Regulations or rules defining and limiting the duties and powers of members of the teaching staff, if it be advisable to make any such, which we are inclined to doubt, should not be included in the set of rules published for the information of the students.

We recommend that the assignment of houses to professors, when vacancies occur, should be regulated by orders laid down by the Secretary of State and should not be left to the discretion of the President.

To the above more important recommendations we desire to add the following:—

(1) That there should always be resident within the College buildings some one member of the teaching staff, and that the College Board should determine the method in which this provision shall be carried out.

(2) That as a matter of economy the offices of Bursar and Secretary should be amalgamated when an opportunity occurs. We cannot agree with the opinion which the President has expressed to us as to the difficulty of getting both duties performed by one man. We assume that adequate clerical assistance is given.

In conclusion, we desire to record our opinion that the equipment of the Royal Indian Engineering College, having regard to the present standard of scientific education, is defective. If the education given at the College is to be made thorough and sufficient, a considerable expenditure must be sanctioned without loss of time for the provision of more lecture rooms, of models, of instruments, and other appliances, without which engineering cannot be properly taught. We wish to draw especial attention to the necessity of providing, before the College reopens after the long vacation, suitable buildings and appliances for the department of Electro-technology. Under present conditions it is impossible for any man, however great his ability may be, to give adequate instruction to the students in electric engineering.

With this Report we submit to the Board of Visitors copies of the evidence taken by us and of written statements laid before us by some of the gentlemen connected with the College. As we have undertaken, for reasons which will be obvious, that this evidence and these statements shall be regarded as privileged, we desire to record our opinion that their publication is not only unadvisable, but would be a contravention of the understanding on which the evidence was given and the statements handed to us.

We append a Memorandum which our three colleagues who represent the Universities desire to place before the Board of Visitors.

(Signed) C. H. T. Crosthwaite.
C. P. Ilbert.
J. Wolfe Barry.
W. H. Preece.
E. H. Busk.
A. R. Forsyth.
G. C. Bourne.

Memorandum.

We have joined in signing the foregoing recommendations because, in our opinion, their adoption will tend to improve the working and the administration of the College, constituted as at present. But we desire to submit some observations to the Board of Visitors, suggested by the inquiry in which we have just taken part; our main reason for doing so is that they are based upon our own experience of academic administration.

We would emphasise the opinion expressed in the Report of the Committee that the entrance examination is not of a character to justify the College authorities in regarding every candidate who obtains a reasonably good percentage of the marks, as possessing the combination of intellectual qualities needed for the Public Works Services. Yet it appears that, of the 36 students admitted last year, 33 have the almost certain prospect of obtaining appointments, provided that they reach minimum qualifying standards.

It might be supposed that the entrance examination could be modified so as to serve the necessary purpose. But it must be borne in mind that as most of the candidates are drawn from the modern sides of public

schools (their work at school being sometimes supplemented by private tuition), the range of the included subjects cannot be much increased, and hardly any new subjects can be added, if such candidates are to attain a reasonable standard in the examination. Further, we do not consider that any examination of the kind can be guaranteed to select men of the desired capacity. It can give no indication of their ability to undergo technical training, because the men themselves have undergone no technical training; moreover, it is held three years before the appointments can be taken up.

As the College stands at present, increased accommodation (in the form of lecture-rooms, laboratories, and the like) is necessary if the teaching is to be done effectively; indeed, some of the departments possess only crude elements of their due installation. To remedy these deficiencies, it will be necessary to expend considerable capital as soon as possible; and additional sums will be required from time to time to meet the frequent changes, and provide the improvements, both in subjects and in apparatus. Every college, whether it is general or technical, that remains in any state of efficiency over such a range of subjects, can be continued only if it is endowed, or if it receives subsidies; and the College at Cooper's Hill cannot be an exception to the general rule.

In order that the Public Works services may be steadily recruited with men of the best ability that can be secured, selection should be made from a much larger field than at present; and this selection should be made only after some training in engineering and cognate subjects had been undergone by the men, who thus will have submitted stronger evidence of their fitness for the services than now is the case. The better selection thus desired would be obtained, partly, at least, if the College could be made an engineering school on a much larger scale, say, twice or thrice as large as at present. But, quite independently of the great expenditure that would be required to secure the sufficient accommodation on the changed scale, it is not improbable that the cost of the College course would deter students from coming in large numbers. It is fairly obvious that the numbers at Cooper's Hill are maintained only because it is known that nearly every student who enters will obtain some Indian appointment. The system seems to us to be of a character that, in actual circumstances, does not make the College the most effective means of supplying the Indian service.

(Signed) G. C. Bourne.
Edward H. Busk.
A. R. Forsyth.

12th July 1901.

No. 6.

Letter from the Under Secretary of State to the President, Royal Indian Engineering College, dated India Office, 15th August 1901.

I am directed by the Secretary of State for India in Council to enclose for your information a copy of the Report* of the Committee of the Board of Visitors of the Royal Indian Engineering College, appointed by the Secretary of State to inquire into and report upon the working, discipline, and constitution of the College and the relations of the Visitors, the President, and the Teaching Staff.

That inquiry having been held, the Board have submitted certain recommendations which have been considered by the Secretary of State in Council, and I am now desired to communicate to you the following instructions for your guidance in the administration of the College:—

1. The sole responsibility for the management of the College and for the general superintendence of the studies will remain vested in the President.

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* Dated 19th July 1901.

The College Board.

2. There shall be a College Board consisting of the President as Chairman with a casting vote, and of the senior Professors of Engineering, of Mathematics, of Natural Science, and of Forestry; and this Board shall be empowered to deal with all matters connected with the studies of the College.

3. The College Board shall meet regularly once a month, whether any question has been put down for discussion or not, and at any time either when summoned by the President or on the requisition in writing of two of the members.

4. Except as provided in Section 6, the opinion of the majority on any matter under discussion shall prevail; but, if the President differs from the majority, he may refer the case for the orders of the Secretary of State.

5. The President or the College Board shall have power at any time to summon a meeting of the whole body of the instructors for consultation on matters connected with the general interests of the College.

Discipline.

6. Disciplinary matters will be retained by the President in his own hands. He shall, however, delegate to the members of the teaching staff such powers as may be necessary to enforce order in the lecture-room and in hall and within the College precincts. In serious cases which call for the severer penalties, such as rustication or dismissal, he shall not act without consulting the College Board, although he need not be bound to accept their advice. The President's decision will be final, but his action shall be reported to the Secretary of State, and in making the report he shall state whether his decision has the concurrence of the College Board.

Appointment and Dismissal of Staff.

7. The appointment and dismissal of the superior staff, all, that is to say, above the rank of Demonstrator, will rest with the Secretary of State, who will in all cases act either on the recommendation of the President or after consultation with him. Appointments will be made during pleasure, and will be terminable by either side with six months' notice, without any reason being assigned. But the Secretary of State may, if he chooses, give six months' salary in lieu of notice; and for any misconduct the Secretary of State reserves the right to dispense summarily with the services of any member of the staff; and in all cases power will be reserved to make the appointment for a year on probation. The condition at present forming part of the engagement, which makes the appointment tenable so long as the incumbent satisfies the President, will be omitted from future letters of appointment.

The appointment and dismissal of Demonstrators and of the Subordinate and Ministerial Staff will rest in the President's hands, but, in selecting a Demonstrator, he shall consult the Professor of the subject.

8. I am to call your attention to the Committee's recommendations regarding the necessity of one of the teaching staff residing always within the College, and also regarding the revision of the present standing orders. The Secretary of State leaves it to you in consultation with the College Board to deal with these matters.

I am, &c.,
(Signed) HARDWICKE.

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